PRICE, 50 CENTS.

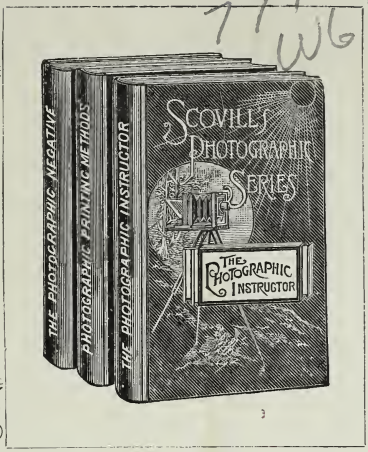
The SCOVILL PHOTOGRAPHIC SERIES

PHOTO-ENGRAVING BY THE HALF-TONE ENAMEL PROCESS.

ROBERT WHITTET

THE SCOVILL & ADAMS CO. OF N. Y.,
60 & 62 East 11th Street, New York.

THE S. & A. PHOTOGRAPHIC SERIES.



Edited by
W. I. LINCOLN ADAMS.

No. 1. THE PHOTOGRAPHIC AMATEUR.

By J. Traill Taylor. A Guide to the Young Photographer, either Professional or Amateur. (Second Edition.) Paper covers..... **$0 50**

No. 5. PHOTOGRAPHY WITH EMULSIONS.

By Capt. W. De W. Abney, R.E., F.R.S. A treatise on the theory and practical working of Gelatine and Collodion Emulsion Processes. (Second Edition.) Paper covers **75**

No. 7. THE MODERN PRACTICE OF RETOUCHING.

As practiced by M. Piquepé, and other celebrated experts. (Ninth Edition.) Paper covers, **50** cents; Library Edition..... **75**

No. 8. THE SPANISH EDITION OF HOW TO MAKE PICTURES.

Ligeras Lecciones sobre Fotografia Dedicados a los Aficionados, Cloth bound, **75** cents. Paper covers..... **50**

No. 12. HARDWICH'S PHOTOGRAPHIC CHEMISTRY.

A manual of Photographic Chemistry, theoretical and practical. (Ninth Edition) Edited by J. Traill Taylor. Leatherette binding..... **2 00**

No. 13. TWELVE ELEMENTARY LESSONS ON SILVER PRINTING.

(Second Edition.) Paper covers **50**

No. 14. ABOUT PHOTOGRAPHY AND PHOTOGRAPHERS.

A series of interesting essays for the studio and study, to which is added European Rambles with a Camera. By H. Baden Pritchard, F.C.S. Paper covers, **50** cents. Cloth bound **75**

No. 15. THE CHEMICAL EFFECT OF THE SPECTRUM.

By Dr. J. M. Eder. Cloth bound, **50** cents. Paper covers..... **25**

No. 16. PICTURE MAKING BY PHOTOGRAPHY.

By H. P. Robinson, author of Pictorial Effect in Photography. Written in popular form and finely illustrated. Library Edition, **$1.00.** Paper covers **75**

No. 20. DRY PLATE MAKING FOR AMATEURS.

By George L. Sinclair, M.D. Pointed, practical and plain. Leatherette binding..... **50**

No. 21. THE AMERICAN ANNUAL OF PHOTOGRAPHY AND PHOTOGRAPHIC TIMES ALMANAC FOR 1887.

(Second Edition.) Paper cover (postage, 12 cents additional).....**$0 50**
Library Edition (postage, 12 cents additional)..... **1 00**

No. 22. PHOTOGRAPHIC PRINTING METHODS.

By the Rev. W. H. Burbank. A Practical Guide to the Professional and Amateur Worker. Cloth bound. (Third Edition).... ..... **1 00**

No. 23. A HISTORY OF PHOTOGRAPHY.

Written as a practical guide and an introduction to its latest developments. By W. Jerome Harrison, F.G.S., and containing a frontispiece of the author. Cloth bound..... **1 00**

The S. & A. Photographic Series.

No. 24. THE AMERICAN ANNUAL OF PHOTOGRAPHY AND PHOTOGRAPHIC TIMES ALMANAC FOR 1888.

Illustrated. (Second Edition.) Paper (by mail, 12 cents additional) 50
Library Edition (by mail, 12 cents additional)..... 1 00

No. 25. THE PHOTOGRAPHIC NEGATIVE.

A Practical Guide to the Preparation of Sensitive Surfaces by the Calotype, Albumen, Collodion, and Gelatine Processes, on Glass and Paper, with Supplementary Chapter on Development, etc., by the Rev. W. H. Burbank.
Cloth bound. Reduced from $1.50 to... ..... 1 00

No. 26. THE PHOTOGRAPHIC INSTRUCTOR FOR THE PROFESSIONAL AND AMATEUR.

Being the comprehensive series of Practical Lessons issued to the Students of the Chautauqua School of Photography. Revised and enlarged. Edited by W. I. Lincoln Adams, with an Appendix by Prof. Chas. Ehrmann.
(Fifth Edition.) Paper covers..... 1 00
Library Edition..... 1 50

No. 27. LETTERS ON LANDSCAPE PHOTOGRAPHY.

By H. P. Robinson. Finely illustrated from the author's own photographs and containing a Photogravure frontispiece of the author. Cloth bound.
..... 1 50

No. 29. THE PROCESSES OF PURE PHOTOGRAPHY.

By W. K. Burton and Andrew Pringle. A standard work, very complete and freely illustrated. Price, in paper covers, **$2 00.** Library Ed., 2 50

No. 30. PICTORIAL EFFECT IN PHOTOGRAPHY.

By H. P. Robinson. A new edition. Illustrated. Mr. Robinson's first and best work. Cloth bound..... 1 50

No. 32. PRACTICAL PHOTO-MICROGRAPHY.

By Andrew Pringle. Fully illustrated. Cloth bound..... 2 50

No. 33. THE AMERICAN ANNUAL OF PHOTOGRAPHY AND PHOTOGRAPHIC TIMES ALMANAC FOR 1890.

Paper cover (by mail, 14 cents additional).... 50
Library Edition (by mail, 14 cents additional)..... 1 00

No. 34. THE OPTICAL LANTERN.

Illustrated. By Andrew Pringle. Paper covers, **$1.00.**
Cloth bound..... 1 50

No. 35. LANTERN SLIDES BY PHOTOGRAPHIC METHODS.

By Andrew Pringle. Paper covers **75** cents. Cloth bound..... 1 25

No. 36. THE AMERICAN ANNUAL OF PHOTOGRAPHY AND PHOTOGRAPHIC TIMES ALMANAC FOR 1891.

Paper covers (by mail, 15 cents additional)..... 50
Library Edition (by mail, 15 cents additional)... ..... 1 00
Cyclopædic Index for 1891 Annual..... 10

No. 37. PHOTOGRAPHIC OPTICS.

A Text-Book for the Professional and Amateur. By W. K. Burton.
Paper covers, **$1.00.** Library Edition.....$1 50

No. 38. PHOTOGRAPHIC REPRODUCTION PROCESSES.

Illustrated. By P. C. Duchochois. Paper covers, **$1.00.** Cloth... 1 50

No. 39. EL INSTRUCTOR FOTOGRAFICO.

Paper covers, **$1.00.** Library Edition.... ..... 1 50

The S. & A. Photographic Series.

No. 41. THE CHEMISTRY OF PHOTOGRAPHY.
By W. Jerome Harrison. Cloth bound..... **3 00**

No. 42. PICTURE MAKING IN THE STUDIO.
By H. P. Robinson. Paper covers, **50** cents. Cloth bound (Library Edition)..... **1 00**

No. 43. THE AMERICAN ANNUAL OF PHOTOGRAPHY AND PHOTOGRAPHIC TIMES ALMANAC FOR 1893.
Edited by W. I. Lincoln Adams.
Paper covers (postage extra, 15 cents)..... **50**
Cloth bound (Library Edition) (postage extra, 15 cents)..... **1 00**

No. 44. THE LIGHTING IN THE PHOTOGRAPHIC STUDIO.
By P. C. Duchochois. A new edition. Paper covers, **75** cents. Cloth bound (Library Edition)..... **1 00**

No. 45. THE GRAMMAR OF PHOTO-ENGRAVING.
By H. D. Farquhar. Illustrated. The most complete text-book yet published on this subject. Price, in paper covers, **$2.00.** Cloth bound (Library Edition)..... **2 50**

No. 46. INDUSTRIAL PHOTOGRAPHY.
Illustrated. By P. C. Duchochois. Being a description of the various processes of producing Indestructible Photographic Images on Glass, Porcelain, Metal, and many other substances. Paper covers, **50** cents. Cloth bound..... **1 00**

No. 47. THE AMERICAN ANNUAL OF PHOTOGRAPHY AND PHOTOGRAPHIC TIMES ALMANAC FOR 1894.
Edited by W. I. Lincoln Adams.
Paper covers (postage extra, 15 cents)..... **50**
Cloth bound (Library Edition) (postage extra, 15 cents)..... **1 00**

No. 48. ARISTOTYPES AND HOW TO MAKE THEM.
Giving a complete description of the manufacture and treatment of Gelatino and Collodio-Chloride Papers. By Walter E. Woodbury. Illustrated. Paper covers, **$1.50.** Library Edition..... **2 00**

No. 49. THE ENCYCLOPÆDIC DICTIONARY OF PHOTOGRAPHY.
Containing over 2,000 references and about 400 illustrations. By Walter E. Woodbury. In preparation.

No. 50. THE AMERICAN ANNUAL OF PHOTOGRAPHY AND PHOTOGRAPHIC TIMES ALMANAC FOR 1895.
With over 200 illustrations. Edited by Walter E. Woodbury, Editor of "The Photographic Times." Paper covers, **50** cents (postage extra). Cloth bound (Library Edition) (postage extra, 15 cents)..... **$1.00**

No. 51. THE PHOTO-GRAVURE.
By Henry R. Blaney. A very complete and practical book, written by an Expert. Paper covers, **50** cents. Cloth bound (Library Edition).... **$1.00**

No. 52. THE PLATINOTYPE: ITS PREPARATION AND MANIPULATION.
By Capt. W. de W. Abney and Lyonel Clark. Fully illustrated. 174 pages..... **$1.25**

For sale by all dealers in Photographic goods, booksellers, and sent, post-paid, on receipt of price, by the publishers,

The Scovill & Adams Company of N. Y.,

Send for Book Catalogue. **423 Broome Street, NEW YORK CITY.**

A Selected List of Books

From the Scovill & Adams Co 's Book Catalogue.

Price per Copy.

Amateur Photography.

A Practical Guide for the Beginner. By W. I. Lincoln Adams. Illustrated. Paper covers, 50c.; cloth bound.. ..... $1 00

Lantern Slides and How to Make Them.

By A. R. Dresser. A new book, very complete and practical..... 25

Photography at Night.

By P. C. Duchochois. Illustrated. 108 pp. Paper covers..... 1 00

History of the Kinetoscope.

By W. K. L. and Antonia Dickson With an Introduction by the inventor, Thomas A. Edison. Fully illustrated. 50 pages..... 25

The Knack.

Written expressly to help the beginner in perplexity, reduced to..... 25

Photographic Lenses; Their Choice and Use.

By J. H. Dallmeyer. A special edition, edited for American photographers. In paper covers 25

The Chemistry of Photography.

By Prof. Raphael Meldola..... 2 00

The Photographic Image.

By P. C. Duchochois. A Theoretical and Practical Treatise on Development. Paper covers... 1 50
Cloth bound..... 2 00

The Ferrotyper's Guide.

For the ferrotyper, this is the only standard work. Seventh thousand..... 75

The Photographic Studios of Europe.

By H. Baden Pritchard, F.C.S. Cloth bound, $1.00; paper covers..... 50

Art of Making Portraits in Crayon on Solar Enlargements.

(Third edition.) By E. Long..... 1 00

History and Hand-Book of Photography.

With seventy illustrations. Cloth bound, reduced to..... 50

Crayon Portraiture.

Complete instructions for making Crayon Portraits on Crayon Paper and on Platinum, Silver and Bromide Enlargements; also directions for the use of Transparent Liquid Water Colors, and for making French Crystals. By J. A. Barhydt. A new edition. Paper covers, 50c.; cloth bound 1 00

Art Recreations.

Ladies' popular guide in home decorative work, with a chapter on photography. Edited by Marion Kemble..... 1 00

American Carbon Manual.

For those who want to try the carbon printing process, this work gives the most detailed information. Cloth bound. Reduced to..... 50

Manual de Fotografia.

By Augustus Le Plongeon. (Hand-book for Spanish Photographers.)..... 1 00

Secrets of the Dark Chamber.

By D. D. T. Davie..... 50

The Photographer's Book of Practical Formulas.

Compiled by Dr. W. D. Holmes, Ph.B., and E. P. Griswold. Paper covers, reduced from 75c. to 30c.; cloth bound, reduced from $1.50 to..... 60

American Hand-Book of the Daguerrotype.

By S. D. Humphrey. (Fifth edition.) This book contains the various processes employed in taking heliographic impressions..... 25

Photographed by Prof. F. Warren Clark. Negative on a Carbutt Half-Tone Process Plate.

DAIBUTSU; OR, GREAT BUDDHA, KAMAKURA, JAPAN.

PHOTO-ENGRAVING

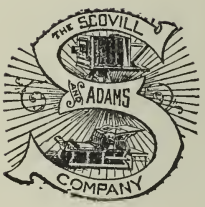
BY THE HALF-TONE ENAMEL PROCESS.

By ROBERT WHITTET.

EDITED BY A. C. LAMOUTTE.

ILLUSTRATED.

New York:
The Scovill & Adams Co. of New York.
1895.



CONTENTS

PREFACE.

THE following trustworthy account of the Half-tone Process by the Enamel Method was written by Mr. Robert Whittet and offered in the competition inaugurated by *The Photographic Times* for the best article, or series of articles, on this important subject. There were many competitors, and Mr. Whittet's paper was selected by competent judges as the most valuable and comprehensive account. It was published in the September (1895) issue of *The Photographic Times*, and the demand for it in that number was so great that the edition was quickly exhausted. As the magazine is printed from type, duplicates could not be obtained. The practical value of the article being so great, and the demand for it continuing, the publishers were induced to reprint it in book form, so that all who desired a copy could obtain it. This puts it in a more convenient, as well as permanent, form, and will consequently be of greater value to the practical reader. It has been carefully gone over by the editor, who writes the Introduction, and an Appendix has been added by him which will be found of practical value by photo-engravers.

INTRODUCTION.

IT will be well to examine what is understood by "half-tone" in connection with the production of typographical plates by photo-engraving methods.

The first experimenters perceived at once that, although it was very easy to produce photographic images on metal plates, they could not be transformed into relief plates except when the subject to be reproduced was composed simply of black and white; the black being represented by the relief portions of the plate, and the white by the hollow portions. Hence, when the model was made up of lines like a steel or wood engraving, or a pen drawing, it was easy to make a facsimile of these lines by photographic mechanical processes, but an ordinary photograph from nature contains, besides the blacks and whites, middle tints, which give life and relief to the image. The great trouble has been, therefore, how to preserve the middle tints, or half tones—whence the process which solved the difficulty derived its name.

It was found that in graining the image—that is to say, transforming it into a multitude of dots—the middle tints could be preserved. This was accomplished by interposing a transparent screen—a piece of glass ruled by machine—between the sensitive plate and the lens. Naturally, the interposition of a screen of this kind divides the image in a series of dots. If these dots were all of the same dimensions as those of the screen there would be no image; but, fortunately for the success of the half-tone process, the diffraction of light comes to its rescue; for the rays emanating from the lens in going

through the screen expand according to their intensity; also, in the places where light is more intense, as in the whites of the model, the dots formed are larger than the interstices of the screen; in the places where the light is of medium intensity the dots are naturally of medium dimensions, while on the dark places the dots are not larger than the interstices of the screen; or, as experience demonstrates, they do not appear at all, leaving those parts completely transparent in the negative. If such a negative is printed on zinc it will give a good reproduction of the gradation of tints in the original.

With all its advantages the half-tone process lingered somewhat in obscurity owing to the tediousness and uncertainty of the bitumen method, until the Americans, discovering its possibilities and great commercial value, undertook to invent the means of producing the desired results with certainty, and at the same time attaining the best artistic effect.

The outcome of these researches was the enamel process which Mr. Whittet describes so clearly in the following pages.

The art of photo-engraving is practically, therefore, an American art, for it has in no other country reached the same degree of perfection.

A great deal of this success is due to the better quality of apparatus used in connection therewith, and we would advise that great care be taken in the selection of the proper camera and lens.

A. C. L.

PHOTO-ENGRAVING BY THE PHOTO-ENAMEL PROCESS.

PHOTOGRAPHERS will no doubt agree that, considering its recent introduction, the extended use of process engraving has been most marvelous, and no less so has been its development in excellence. Within the last decade it was a secret watchfully guarded by the few who had laboriously studied and experimented until the reward of success was attained; but the results were so manifestly beautiful and interesting that inquisitorial curiosity was not slow to set itself to discover the secret methods of the early manipulators, and with so much success that new operators have started in every direction, each adding some new feature, or some fancied new wrinkle, peculiar and secret to himself, until the art has leapt into importance and excellence with such rapid bounds that there has been no time to acquire a history. Notwithstanding the extreme privacy with which the process has been guarded, there is not so much of difficulty in it but that it may be readily acquired by any one willing to put himself to a careful study of the principles of the art, with sufficient mechanical turn of mind and dexterity of hand, and the exercise of patience and perseverance, until it is attained. In the following pages is presented a description of the process so full in the various operations, and of the essential and necessary minutiæ, that a careful attention to them can hardly fail to bring out successful results.

Initiatory Operations.—The process in its entirety consists of three distinct operations: 1. Making the negative. 2. The preparation of the metal plate, zinc or copper, to be engraved. 3. The etching; to which might be added a fourth,

the mounting of a plate on a wood block preparatory to printing, but which is so entirely dissimilar from the process of engraving, and so purely mechanical, that it may scarcely be considered as belonging to it further than necessary to make available to its ultimate purpose the plate which has been already completed so far as engraving is concerned. These several operations we will endeavor to explain in as minute and practical a manner as possible, both as to formulæ and method of manipulation, so that the tyro may attain to a degree of excellence proportionate to his inteligent apprehension and diligent and persevering prosecution of the methods described.

The Negative.—Gelatine dry-plates are now specially manufactured with a view to suiting the process, and no doubt when the light employed is of a character that will secure steadiness and uniformity—as when the electric arc light can be made available—these will be found very convenient; but as the novice will probably be dependent on the ordinary light from the luminary of day, which is so very variable and liable to cloud and shadow, the dry-plate would be found too uncertain in result, and the consequent waste too expensive for the beginner. He will hence find it most economical to adopt the wet-plate process of the old-time photographer. In prosecution of this his first attention will be to the choice of glass, for which he will find crystal plate, about one-eighth of an inch in thickness, to be the most suitable, by reason of its being uniformly clear and free of bubbles and scratches. There are other makes, however, of varying excellence, and it will be well to see that what he uses is of good clear color, flat, and as free of imperfections as he can procure it.

Cleaning the Glass.—Having procured the glass, the next operation is to have it thoroughly cleaned; and in this, as, indeed, in every subsequent part, scrupulous cleanliness is a *sine qua non* to success. This is best effected by allowing it to steep in a strong lye for several hours, say over night, and after a thorough rubbing on both sides with a piece of clean coarse cloth under the tap, put it into a dilute solution of nitric acid—of, say, three ounces to the gallon of water—and let lie

for at least half a day, and none the worse for a longer time. From this it should be again washed and rubbed with the canvas cloth under the tap, until it is seen to be absolutely clean by examining it toward the light. It is sometimes found that the water from the public reservoirs, from impurities held

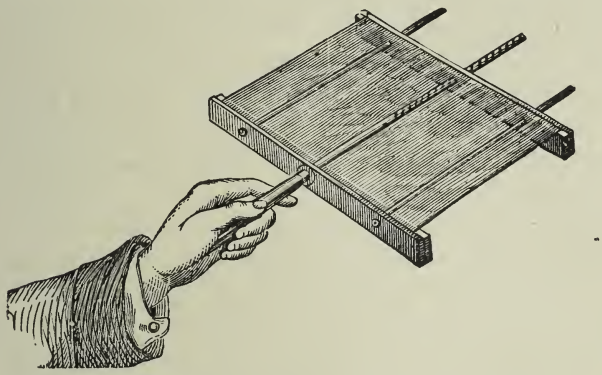


FIG. 1. HOLDER FOR GLASS PLATE WHEN CLEANING,

in solution, leave a stain or cloud on the plate after drying; in such case it will be needful after washing to give a last rinsing in pure water, either distilled or melted ice, filtered, which may be contained in a dish laid conveniently for the plate to be laved in it.

Albumenizing the Glass.—The next operation is the albumenizing of the glass. This is necessary as a substratum for the collodion to be afterward flowed over it. This is done immediately after rinsing from the pure water last used in washing. The proportions of albumen to water are very varying among operators in practice, some using the white of one egg to twenty-five ounces of water, while others give to the same quantity of albumen eighty ounces of water. Any proportions between these will work, the main idea governing being the injury to the silver bath, which may result by the gradual communication to it of organic matter from this source. It will readily be understood, however, that a very thin or delicate solution is all that is necessary, and the white of one egg to forty-eight ounces of water will be a desirable medium to adopt.

Albumen Solution.—To prepare the albumen solution, take the white of a fresh egg, careful that none of the yolk or the germ is accidentally admitted. Break this into a froth with an ordinary egg-beater, and mix with forty-eight ounces of water. This should be the purest procurable, distilled, or from melted transparent ice, and filtered before use. Thoroughly mix by beating again with the egg-beater; neutralize by adding five or six drops of acetic acid, and let stand over night. Before using, it must be frequently filtered through absorbent cotton until it is seen to be thoroughly clear and limpid, and with no shreds of albumen visible. To get it to this condition will necessitate filtering three or four times, and it will be found most convenient to take several graduates of varying sizes with a funnel containing the cotton in each, and pass from one to another, till the last be found in condition of sufficient purity to be flowed over the plate.

Flowing the Plate.—With the glass perfectly clean, immediately after rinsing in pure water, as above recommended, take the graduate containing the last filtered albumen solution in the right hand, while the glass is held in the left by the lower left-hand corner; pour the solution copiously on the plate at the upper right-hand corner, and allow to flow gradually over it, and run off at bottom. Flow at least twice, as much as possible preventing any from reaching the back, because of its not being necessary there, and of the injury it may afterward inflict on the silver sensitizing bath. After flowing twice, set up the plates on a rack to dry spontaneously, being careful to arrange them with the albumen side turned one way, as it is hardly possible to discern after drying which side has been albumenized. After drying, they may be stored in some convenient cupboard or shelf, and protected from dust by a cover being kept over them. Any number may be thus prepared at once, as they will keep for any length of time.

The Collodion.—The next further stage in the process is the preparation of the collodion. This may be purchased ready prepared, but no work on the subject would be complete without the formula for making, and its preparation presents no great difficulty. There are many recipes, varying some-

what with the fancy which some operators think they have discovered in a few grains less or more of some one or other bromide or iodide salt, but all practically bringing out the same result; the supposed excellence of one more than another probably resulting from the methods of handling the after operations. The following will be found to be one of the best:

Alcohol, 95 per cent	8 ounces
Iodide of ammonium	48 grains
Iodide of cadmium	24 grains
Bromide of cadmium	16 grains
Pyroxyline	120 grains
Sulphuric ether	8 ounces

Dissolve the salts by grinding each separately in a mortar with a portion of the alcohol in the above order; add the pyroxyline and shake well; last, add the ether, and, after shaking, the whole will be seen to dissolve into a clear liquid of amber color. It will be sufficiently ripened to work in a few hours, but will improve as it gets older. The ether being very volatile, it should be kept in glass-stoppered bottles. There are bottles manufactured for the purpose—"collodion pourers"—but in the absence of these an ordinary wide-mouthed bottle with glass stopper is an excellent substitute. The most convenient shape is that shown in Fig. 2. It allows all impurities to settle in the bottom, so that the collodion may be poured out without disturbing them, and the formation of the bottle is also such that air bubbles are not formed when pouring out the solution.

FIG. 2.
COLLODION BOTTLE.

Flowing the Collodion.—To so flow the collodion over the plate as to give a uniform coating requires a little dexterity that can only be acquired by practice. Take hold of the glass by the lower corner in the left hand, stretching the forefinger along the edge so as to give support at that point, while the thumb and middle finger support the bottom (see Fig. 3). Now, holding it as level as the eye can judge, pour a pool of

collodion about the centre, or nearer the top, of the plate with a steady, even flow, and of sufficient quantity to cover it. Incline the glass so as to make the collodion flow first to the upper right-hand corner (to No. 1), then over to the left (to No. 2), and then down to the bottom to No. 3), allowing the surplus to flow off at the lower right-hand corner (at No. 4), into a wide-mouthed bottle, kept for the purpose, and fitted with a stopper or cork. This can be afterward utilized by filtering, and adding to the stock bottle.

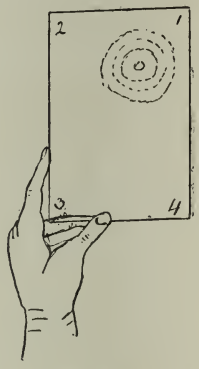


FIG. 3.

The important object is to have a regular coating all over the plate; and to attain this there must be no hesitation in the pouring and flowing over the whole surface, and then, by raising it into a perpendicular position, allow the surplus to drain, at the same time giving it a to and-fro motion sideways, but by no means such as would send it back over the plate. Having an eye to the careful preservation of the silver bath, wipe off all superfluous collodion that may have got on the back of the glass. It would set in a few seconds, indicated by its drying or thickening so as to take the impress of the thumb at the lower corner where last poured off. Whenever this is noticed it is ready to be lowered into the sensitizing bath, which should be done without delay.

The Silver Bath.—It is very important that the silver bath should be made from the purest materials. The water especially should be carefully filtered and purified. The most efficient method of accomplishing this is to take distilled water, or transparent ice melted; add to it a few crystals of nitrate of silver, put into a bottle of white glass and set in the sun. In a few days it will darken corresponding to the amount of organic matter contained in it, which will be precipitated and can be filtered out. Make up a sufficient quantity to fill the bath holder of the size determined upon. This may be a flat dish—which will call for a less quantity of silver, but not on that account more economical—or a regular glass holder with box and cover, which is greatly to be preferred, being much

more easily managed in respect of the plate, but also for keeping the bath in better condition (see Fig. 4). A size 11 x 13 will be found a serviceable and convenient size to work with. This will require 100 ounces, which should be of the strength of forty grains to the ounce, tested by an argento-

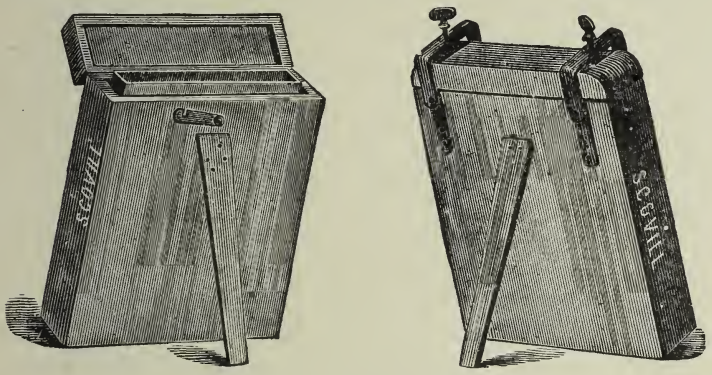


FIG. 4. SILVER BATH.

meter (Fig. 5). Put this quantity into a large bottle of white glass, add to it a few drops of concentrated ammonia, to neutralize, until it just turns red litmus paper blue, and set in the sun for several days to clear. Any organic matter contained in it will be precipitated, or adhere to the sides of the bottle, which must be thoroughly filtered and cleaned out. Filter again and again until assured of being thoroughly pure, by its remaining clear. When ready for use put into the bath holder, add a few grains of iodide of potassium—5 grains will be sufficient—and of nitric acid, C. P., a few drops at a time, until it turns blue litmus paper a decided red, when it will be ready for use. In place of adding 5 grains of iodide of potassium, a collodionized plate may be placed in the bath and allowed to remain over night, when sufficient of the iodide will have been communicated to it from the collodion.

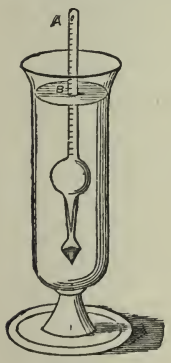


FIG. 5. ARGENTOMETER.

The Care of the Bath.—The care of the bath is a matter

of much importance, as it is liable at times to go out of order for causes not easily discoverable, there being many that affect it, which may set their evil influences into operation suddenly; but the chief source is from organic matter introduced through the medium of the collodion and the glass plate, and should be carefully guarded against. In time it will have become so surcharged with alcohol and iodine from this source as to require doctoring, which condition may be known by the developer flowing over the plate as if meeting with a greasy resistance, and later by minute pin-holes like star dust being observable in the negative. The first of these may be corrected for a time by the addition of a little alcohol to the developer; but be assured that the other is not far away, and then it will be needful that drastic measures must be adopted. To this end take a quantity of pure distilled water, or melted ice purified, equal to the bulk of the bath; pour the bath into it, filter out the iodides and simmer down by gently boiling in a granite or porcelain dish (Fig. 6) until it is reduced to considerably less than the original bulk. This operation will have evaporated out the alcohol. Let it now be brought to the strength of 40 grains to the ounce, by the addition of pure water, neutralized by the addition of a few drops of concentrated ammonia, and set in the sun, where the organic matter will be precipitated, and may be filtered out. A longer sunning and filtering will further improve it, and after assurance by its remaining clear, it may be acidified as at first and again put to work. Because of the liability of the bath to go out of order, it is well to have one or two distinct baths under process of sunning and purifying, besides the one in use, and so save disappointment at inopportune times. Before beginning the work of the day the bath should be skimmed over with a piece of clean blotting paper.

The Dark-Room.—The dark-room should be arranged with everything so conveniently placed as to be readily found in the dim light necessary. This need not be so very dim, however, as to become a source of confusion, the wet-plate not being nearly so sensitive as the gelatine dry-plate of the photographer; but the light must be made non-actinic in character,

by being strained through a colored medium, either of glass, cloth or paper, that it may not affect the sensitized plate while it is being taken out of the bath and placed in the camera-holder. If the light is taken from an outside window, it may be partly blocked out, while a portion may be covered with orange-colored cloth or paper. A clearer light will be obtained in which to observe the action of the developer, by placing a pane of ruby colored glass into a section of the sash. If dependent on gas or artificial light it should be enclosed in a lantern or other enclosure, and protected by ruby or orange-colored glass. The incandescent electric light is very convenient when it can be readily obtained. The sink and water-tap should be so placed with relation to the light as to be readily accessible at the moment development is seen to have reached the desired amount of detail.

FIG. 6. EVAPORATING DISH.

Sensitizing the Plate.—The bath having been prepared and in working order, the next operation is to make sensitive to light the glass plate. This having been flowed with the collodion as described is laid on the dipper, and, with a steady, unhesitating motion, lowered into the bath, stirring it a few times, but not raising it so high as that any part of it will be out of the solution. This may be done with the full light up in the dark-room; but in placing the plate into the bath let it be shaded by the person or otherwise, until the cover is placed over it, otherwise "fog" may be the result. It should be allowed to remain in the bath until sufficiently sensitized, for which five minutes is about right, though with a bath that has been some time in use a few minutes more will do no harm.

In taking the plate from the bath, raise the dipper with the same steady motion as in inserting, as any stoppage will surely leave a mark across the plate. Allow to drain for a few seconds, and then set against the wall or other support, and wipe the back with blotting paper, and place in the camera plate-holder, which has been previously set to fit the plate and

screen. As heretofore arranged the screen and its frame or holder is of size to fit the size of plate used; but recently a plate-holder has been invented accommodating any size of screen or plate, and with a device by which the separation of

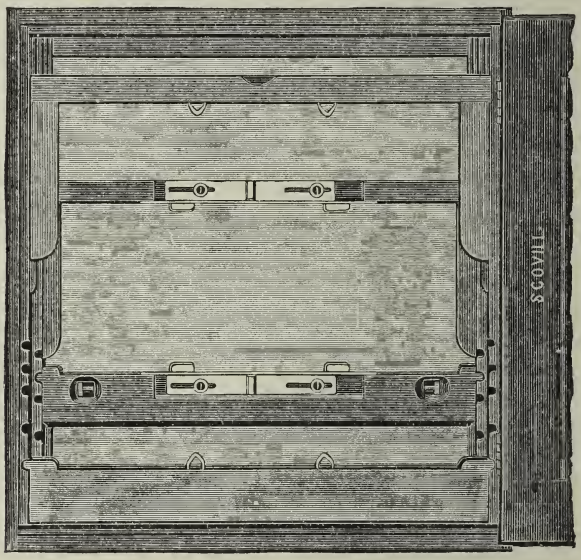


FIG. 7. SCOVILL SCREEN PLATE HOLDER.

the screen and plate may be regulated to a nicety, which must prove a valuable adjunct to the working plant of the process worker (Fig. 7).

The Screen.—At this point it may be well to consider the screen and its use. It is an indispensable accessory to half-tone work, for without its assistance it would be impossible to etch plates from photographs or wash drawings capable of being printed by the typographic process. By its influence the picture is broken up into minute points, which present a surface to the inking rollers of the press, without filling up the interstices between, and so preserving the picture. According to the fineness of the ruling of the screen will be the fineness of the resulting print, but, on the other hand, it will call for superior paper being used and greater dexterity in workman-

ship in the printing. The fineness of the screen should therefore be commensurate with the ultimate intention in the use of the engraved plate. If it is to be printed on a common quality of paper, then a screen of coarse ruling—say of 80 lines to the inch—should be employed, while screens of from 132 lines and up to 175 will necessitate the finest coated paper and the most skillful presswork. For more ordinary work screens of 120 to 124 lines to the inch will be found most serviceable, but to get the best results out of these, a good coated paper and an experienced workman at press is needful.

Distance of Screen from Plate.—But a matter of much importance in working with the screen is the distance of separation between it and the sensitized plate. This distance will range from one-sixteenth to one-eighth of an inch, to be regulated according as the desire of the operator is to get the high lights up without using a larger stop, or giving longer time of exposure. The use of the screen in this respect will be understood when it is pointed out that the influence of the wider separation is to allow the light so much more space in which to spread, and thus fill up the high lights. With this fact kept in mind a wide field is open for experiment, and the acquisition of practical knowledge, which can only be thus attained.

Cleaning the Screen.—It is of the utmost importance that the screen be absolutely clean, and to get it so is more difficult than might be expected, the smallest stain from the fingers or

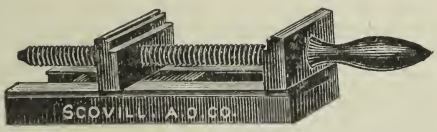


FIG. 8. PLATE VISE FOR HOLDING GLASS WHEN BEING POLISHED.

other source being observable on the negative. Perhaps the simplest way to clean is to fix in a screw vice, which is made for the purpose, and not costly (see Fig 8). Keep a little of the finest French chalk mixed with alcohol at hand, and apply a few drops, rubbing over the surface, afterward polishing with a little pure alcohol or distilled water, applied with

some absorbent cotton, and lastly rubbing up with a clean bit of soft, old silk. It takes a close scrutiny to discover streaks, and a careful examination in all lights is necessary.

The Camera.—Having inserted the sensitized plate and closed the holder, the next operation will be with the camera.

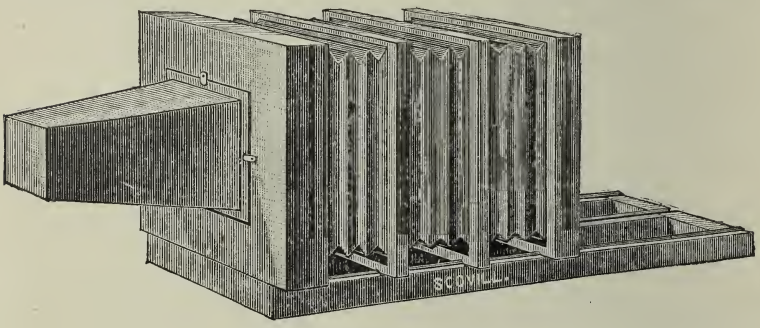


FIG. 9. COPYING CAMERA.

This should be of size to accommodate the screen and plate chosen, and be erected on a platform on which it can be made

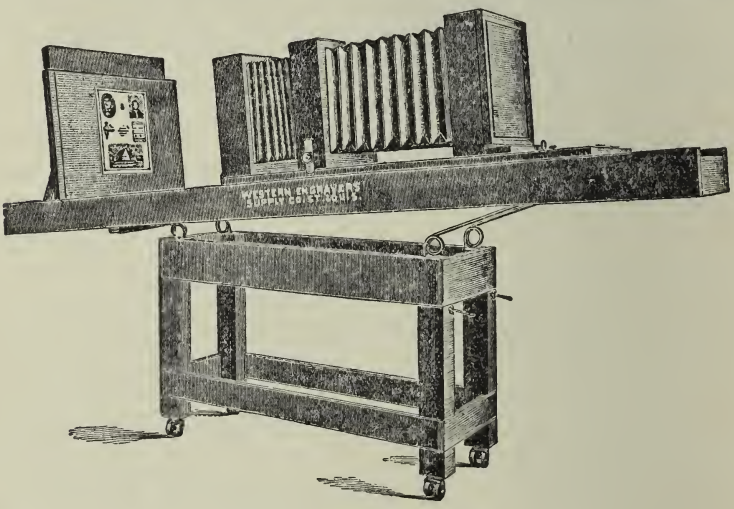


FIG. 10. CAMERA STAND.

to slide far enough for considerable reduction being made. There must be perfect vertical alignment between the camera

and the picture to be copied, and this is best attained by the copy-holder being placed on the same platform, and also made to slide on it (Fig. 10). A platform about 10 feet long will be found a useful length for ordinary work. It may be conveniently erected on a table with castors that it may be readily moved about, and springs that may counteract any vibration that may occur during exposure. The camera and copy-holder being placed on the same platform, any vibration occurring will be imparted to both plate and copy alike. Another

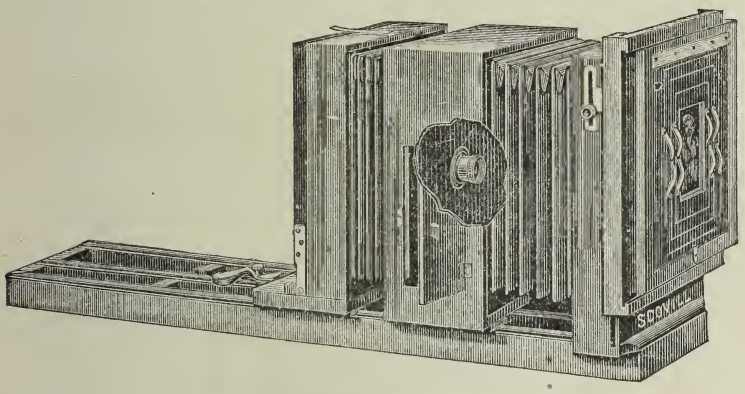


FIG. 11. ENLARGING AND REDUCING CAMERA.

method of counteracting any vibration is to suspend the platform with camera and copy-holder from the roof; but unless the operator's light is from a steady source the former plan will be found most convenient, as it can be shifted about so as to suit the direction of light at any time of day. Fig. 12 will explain what is meant.

The Lens.—The lens is perhaps the most important item of the process worker's outfit. There are many good lenses on the market, and those of any of the reputable makers will afford a guarantee of suitability. It will therefore be the truest economy to procure the best the intending operator can afford to purchase, and he has a wide choice. It should, however, be of the rectilinear class.

A lens that has met with considerable favor with half-tone engravers is the Steinheil Wide-Angle Aplanat, Series VI.

(See Fig. 13.) It gives perfect flatness of picture and sharpness of image, together with considerable field.

The Diaphragms.—The diaphragms or stops, as more familiarly spoken of, are an important adjunct of the lens, and considerable judgment is necessary in the use of the several sizes, which can only be acquired by experience. It should be kept in mind that they are related to each other by regular gradation, and that the diameter of each is a proportion of the

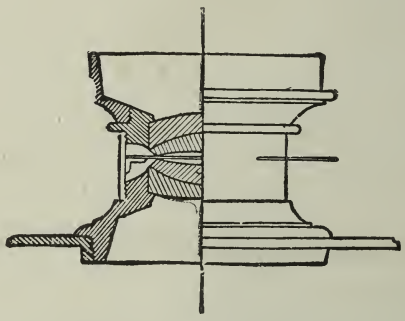


FIG. 13. STEINHEIL LENS.

length of focus of the lens. The gradation followed as a rule gives a value double—*i.e.*, admitting double the amount of light—that of the smaller one immediately preceding. One or two general rules regulating their use may be laid down for easy remembrance: 1st. In copying a picture and making a considerable reduction, use a small stop, commensurate with the amount of reduction. 2d. A small stop gives greater detail in the shadows, sending the light rays more directly, or in straighter line, through the screen. 3d. The larger stops allow the light to spread, and so have relatively a greater influence in filling up the high lights. Keeping these rules in view, it will be readily comprehended that the use of too large a stop will fill up the high lights of the picture before sufficient detail could be got in the shadows, and the inference naturally follows that when a lack of detail is observed a smaller stop should be used. The character of the picture to be copied has also to be judged, and as a rule, should it contain much of dark shadow, a small stop and longer time of

exposure is indicated, so as to get enough of detail. It is a good method and will bring out the best results to use several stops—say, two or three—and proportion the time with each as to give detail in the shadows by so much given with the small stop, so much more given with the next larger, and possibly a shorter exposure with a still larger for the high lights. It is well to aim for getting the high lights right, the

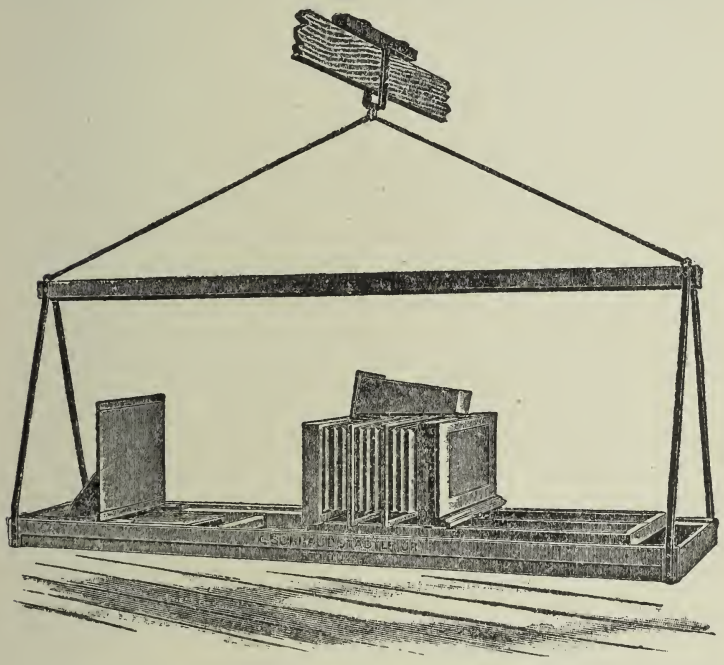


FIG. 12. CAMERA SWING.

detail in the shadows being more easily got by giving more exposure with the small stop.

Diaphragm Apertures.—The stops or diaphragms sent with lenses as purchased usually have their apertures round in form; but recent investigation has shown that other forms may be used with advantage. Square apertures, or square with the corners cut out, also diagonal, as follows, are each seen to have a varying influence on the shape of the dot, and through it on the picture resulting, Every square in the

screen acting as a separate lens causes the dots to partake of the shape of the apertures used. This investigation has been very fully made by Dr. J. M. Eder, of Germany, and Mr. Levy, of Philadelphia. The latter gentleman gave the result of his investigations in a very interesting article in the *Paper and Press*, and has invented a form of diaphragm in which the shape of the aperture may be modified or changed, as shown in Figs. 14–17. The elaborate writing of Dr. Eder has been translated and published in the *Process Photogram*, of London, England, and from it we extract the following paragraph, as presenting the gist of the whole:

"With square diagram apertures the preparation of half-tone negatives is rendered easier and more certain than with round ones; the reason of this lies in the fact that the corners of the square negative dots in the high lights beautifully

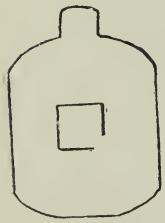


FIG. 14.

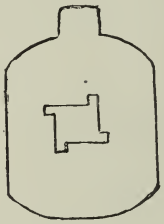


FIG. 15.

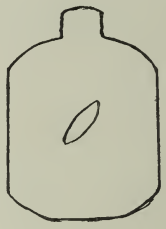


FIG. 16.

FIG. 17.

coalesce, by which means the dot remains open, so that the square stops—even if their ratio aperture may not be so great as that of the round ones—it is easier to obtain undulated half-tone negatives. Square stops with the corners cut out act still more favorably under some conditions. A square stop with corners cut out I especially recommend for half-tone work; the beginner should commence his experience with such a stop. The influence of the diagonal aperture is to present the dots in lines, and this will be more readily observed if one half the time allotted to this form be given the one way, and the diaphragm turned round so as to give it in the other direction. These special diaphragms may be made in card-board and blackened."

The Copying Board.—The copying board should be so

placed as to be conveniently shifted to accommodate any reduction or enlargement that may be required, but at the same time retain its being in position perfectly vertical to the camera holder. This is secured by being erected on the same platform as the camera, and running in the same grooves, as explained in the foregoing diagram. The copy may be affixed in any way convenient, only where special means have to be adopted to keep it flat, perhaps the simplest way is to place a piece of plate glass over it, for which it is as well to make provision, so it may be readily fixed and at the same time

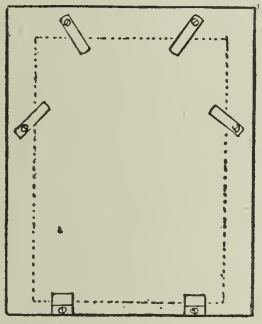


FIG. 18.

impinge with some pressure on the copy. With a couple of catches of thin brass at the bottom, to support the weight of the glass, into which a wedge of folded paper may be pushed to keep it tight, and pieces of spring brass at sides and top, secured with a screw at end, so that it may turn in any direction and hold, it will be found all that is needful (see Fig. 18). In the use of a plate glass cover, however, it should be seen that no reflections proceed from it, and if there are, means must be taken to obviate them. And this leads us to the next important consideration, that of

Light.—If you have access to the skylight of a photographer's gallery, or can erect such, you are all right, and have at hand a most potent assistance in securing suitable negatives with greater certainty and with less perplexing judgment. But you may be dependent on a side light from a window, with every variation of cloud and sunshine, rain or clear weather, while volume and intensity will also vary with the

season, and it will call for the exercise of much study and waste from many trials on plates, and patience, to secure the exact conditions of a good negative. A northern light will give the most steady and have less variation, but more frequently one has to make the most of what he can get, and then it lies for the man of inventive parts to bring out good results from circumstances as he finds them. Direct sunlight may even be used, and good negatives secured by it with very much shortened time of exposure.

Exposure.—The varying circumstances of light—the fickle clouds and the uncertain haze, the meridian glare and the slanting ray of the morning and evening, as well as the summer's glow and the winter's mist—render the time of exposure a matter of exceeding difficulty, which experience only can overcome, and enable one to attain to the exercise of a just judgment. It may be mentioned, however, that an exposure through a screen for a half-tone negative will take about four times that of a negative intended for line work. Before uncapping the lens examine the conditions of the light, and determine what stops you will use, and mark down on a slip of paper the time you intend to give to each, then turn the hands of a striking clock to the time allotted to the first stop, and the instant of its striking will give a perfect warning that time is exactly up, when the lens may be capped and the stop changed, and the clock again set to keep its vigils for the fullness of time.

Exposure Example.—As an example of approximate timing, we will suppose a picture to be copied, and to be reduced to about one-half. Referring to what has been said regarding stop apertures on p. 135, we would use that marked No. 1, or a round aperture of same size, say *f*/75, and give seven minutes; then change to No. 2, *f*/50, and give two minutes; change again to Nos. 3 and 4, same size, and give one minute each; being eleven minutes in all, with a fairly clear light, through a screen of 120 lines to the inch, and with a rapid rectilinear lens of a reputable make. The light, or other circumstances, may call for a different exposure, but this is given as an example that will be found nearly correct.

The Developer.—Make a saturated solution of the proto-sulphate of iron, of which take twelve ounces, and add to it two ounces of acetic acid and twenty-four ounces of water. Some, add a little alcohol, but this is not necessary unless the silver bath is getting out of order from use, or the accumulation of iodide, alcohol, or organic matter in it, which may be known by a difficulty in flowing the developer over the plate, and may be accepted as a warning to see after a new bath, and an early rectification of the old.

The Fixing Chemical.—The agent used to fix the picture, or destroy the sensitive character of the plate, is the cyanide of potassium, made up in solution in the proportion of one ounce of cyanide to twelve ounces of water. It is highly poisonous and should be carefully kept from any scratches or brasures on the hands and so save any risk of blood poisoning.

Development.—The exposure made, retire with holder to the dark-room, which we have supposed to have been fitted up with sink, water, and the usual necessary equipment of such "dens." The developer and the fixing chemical are supposed to be lying convenient to hand. Take the plate from the holder, and, holding it by the corner in the left hand, flow the developer with a steady and rather copious sweep over it, yet permitting as little as possible, or none, to overrun. Flow back and forth until the appearance of the image, which, if correctly timed, should be in a few seconds, and watch for the coming of the details of the picture, and on the instant that they are seen to be sufficiently full, stop further development by putting the plate under the tap, and letting the water flow freely over it. Guard against over-development. If allowed to go too far, there will be a veil or fog over the plate, which it is difficult to get rid of, with great risk of spoiling the negative in the attempt.

Trimming the Negative.—The development having been carried as far as desired—*i.e.*, with the detail fully out, but no more—and washed with a generous flow of water, it is now ready for being "fixed," that is, the image rendered non-sensitive to the light, which is done by flowing over the plate the before-mentioned solution of cyanide of potassium, when the

whole picture will be seen immediately to clear up. Before doing so, however, it is well to trim up the negative by scraping away with the thumb the film from the outer margin of the picture, allowing about an inch or so to remain. As the film is very rich in silver, a small receptacle should be provided, easily found in the dim light of the dark-room, where that portion scraped off may be put and preserved.

Examination of the Negative.—The plate may now be taken into the light and examined through a microscopic focusing glass, and the attention first directed to the condition of the dots seen in the high lights, *i.e.*, the dark portions in the negative. These will have come right, if they almost, but not quite, touch each other, while the dots in the half-tones will be of size varying as they tend to light or shade, and the deeper shadows will have smaller dots, but sufficiently pronounced to permit a little diminution in the after process of clearing. Should the high lights not be closed enough, and instead show considerably wide cross lines, then a longer exposure with the larger stop, or possibly increasing the distance a trifle between the screen and plate is indicated. If the dots in the shadows are not sufficiently strong, then a smaller stop, or a longer exposure with the smallest stop used, is the remedy. Keeping these rules in mind, with a little practice, the operator will soon master the principles and attain familiarity in working.

Intensification.—However well defined the image may appear on the plate at this stage, it is never so clear as that a satisfactory plate could be engraved from it. It requires to be "intensified." To do so there are two methods that may be adopted, both of which have their advocates. One of these uses the bichloride of mercury as the agent, the other employs a solution of the sulphate of copper and bromide of potassium with nitrate of silver. The formula and operation with the first are as follows:

Bichloride of mercury	2 ounces
Muriatic acid	½ ounce
Water	25 ounces

Allow the plate to remain in this solution till it is bleached

white, when it should be well washed in running water, and then flowed over with the following:

Hydrosulphuret of ammonia.....1 part
Water.....4 parts

This will make the plate an intense black. After being well washed it should be flowed over with a weak solution of nitric acid, in the proportion of 1 drachm to 4 ounces of water, well rinsed under the tap and set aside to dry. It should be mentioned that the bichloride of mercury is the well-known corrosive sublimate, a deadly irritant poison, and should be used with extreme caution.

The formula and operation with the other method are as follows:

Sulphate of copper.....25 grains
Bromide of potassium.....15 grains
Water.....1 ounce

Flow this solution while the plate is held in the hand. It will at first discolor or darken the film, but in a few seconds will bleach to white. After it has whitened through, let the tap flow over it till thoroughly washed, which will take about five minutes. The washing should be uniform all over, and if allowed to lie under the tap the water should be directed in an equal stream over all parts. It should then be flowed over with the following solution:

Nitrate of silver.....40 grains
Citric acid..... 8 grains
Ice or distilled water.....1 ounce

Under this application the plate will blacken over, when it should be again thoroughly washed.

Clearing the Negative.—It is more than probable that it will not yet have been sufficiently cleared to print, in which case it should be flowed with the following solution of iodine:

Iodine.....40 grains
Water..... 4 ounces

with iodide of potassium added in small quantities at a time and shaken until all the iodine scales are dissolved. This will

be of a deep brandy color. After allowing this solution to act upon the film a few seconds, it should be well rinsed in water under the tap, and flowed with a *very* weak solution of cyanide of potassium, which will instantaneously whiten over the film, and the image will be seen gradually to clear up. Great caution, however, is needful in this operation. Should the cyanide be too strong, or allowed to act too long upon the film, it will sweep away the dots in the shadows, or cut away so much as to render the negative valueless. The tap should be kept running while operating with the cyanide solution, ready to stop its action the instant it is seen to clear up. If an examination reveals that it is not yet sufficiently clear, the operation may be repeated. Should any part be seen to require clearing more than another, a small stream of the cyanide solution may be so poured from the graduate as to be directed on the clouded part without reaching the rest, though to do so will require delicate handling and much caution, as, a little overdone at this point, the whole negative may be spoiled. When seen by examination with the focusing glass to be sufficiently cleared with the cyanide, it should be again well washed, flowed with the foregoing weak solution of nitric acid, and afterward blackened with the solution of sulphuret of ammonia mentioned above, flowed again with the nitric acid, washed and set aside to dry. Wash well after flowing with all the solutions.

Features of a Good Negative.—It is to be hoped that the result of so much labor, necessitating so much careful handling, and the exercise of so much judgment, will be a good negative. If it is not satisfactory it will be but labor lost to proceed further, and it will be well at this point to describe what constitutes a good negative. Give it a minute examination under the glass. The darkest portions of the negative, which will be the high lights in the finished picture, should present a small, clear, transparent dot. The effect of the intensification should have been to close up the black dots which, after development, almost touched. If there are cross lines of white instead of the small dot, the high lights in the finished picture will be correspondingly dark, and the whole effect will lack contrast and pluck. The black dots

in the half-tones should vary in size down to the very small in the deeper shadows, and where strong contrast is wanted they may in some portions be down to nothing. Should the finished negative not present these features, it were better, in the spirit of *nil desperandum*, to throw it aside, and begin again at the beginning, hoping for "better luck next time."

The Marginal Line.—The resulting negative proving satisfactory, the further operations may be proceeded with, and the next, unless a vignetted effect is wanted, a marginal line should be run around the picture, giving it a finished appearance, and affording a guide for the router in mounting. With a square or straight edge laid along the margin of the picture, run the point of a graver along; this will make a clean cut through the film, which will print black in the finished picture.

Turning the Film.—The film has now to be prepared for turning, otherwise the picture would appear reversed in the after printing. Though to turn it is by no means a difficult operation, it requires delicate handling, and is most interesting. To enable its being so turned it is first given a coating of india-rubber dissolved in benzole, made as follows: Cut half an ounce of pure virgin rubber into small pieces, and place in a bottle with about 8 ounces of benzole, giving it a good shake occasionally. In a few days it will dissolve. It should be about the same consistency as good collodion, and if found too thick it may be thinned by the addition of more benzole. It must not be too thin, however, otherwise it will not be sufficient to resist the action of the collodion which is to be afterward applied and which would eat away and destroy the film. After the benzole has evaporated and left the rubber in a thin layer dry over the film, it must be flowed over in the same manner with "stripping" collodion, made after the following recipe:

Alcohol	4 ounces
Pyroxyline	60 grains
Sulphuric ether	4 ounces
Castor oil	30 drops

The castor oil is added to make the film adhere to the

glass after being turned. It is ready for turning any time after the collodion has set and dried.

At this stage the film should be cut through with a sharp knife about a quarter of an inch from the line marking the margin of the picture. It is now to be placed in a solution of acetic acid, of quantity sufficient to cover well, and proportioned as follows:

Acetic acid	1 ounce
Water	8 ounces

In a few minutes the film at the outer edges will readily be picked away by raising it at the corner with a penknife. After stripping away the outer portion, and leaving only the picture on the glass, put under the tap and wash well, but carefully, and lay on a table, with plenty of water upon it. Now take a piece of stout common printing paper, somewhat larger than the picture and within the size of the glass; wet it by drawing it through water, and lay it over the film; next squeegee the water from it till smooth, raise the corner, and with the point of a penknife pick up the corner of the film, just enough to catch hold of it between the finger and thumb, keeping the paper for support, and gently pull both together from the glass. It will readily come away. Lay it down upon the glass, film up, and smooth out gently with the squeegee, or the point of the fingers, any wrinkles that may have come on it. If the wrinkles are numerous, or the film too delicate to handle with the squeegee or the fingers, a gentle flow of water will expedite the operation, being cautious, however, not to flow so sharply as to float it off! Now draw another piece of paper through water, and lay it over the film, squeegee again, and lifting both papers, having the film between them, from the glass, turn right over, and remove the first piece of paper, which will now be uppermost. The film may now be lifted with its paper support and set aside, and the glass thoroughly cleaned under the tap. So cleaned, lay the glass on the table with plenty of water, lay the film, with its paper support uppermost, in the centre, and squeegee the water from it. The paper may now be lifted and the film examined and smoothed out gently with the squeegee, and the

paper replaced over it. With two or three layers of blotting paper over it, it should be placed under a board and a weight for about half an hour, when it may be taken out and set aside to dry.

Preparations for Etching.—The negative is now ready for being printed from, and the student's attention will now be directed to the preparation of the metal plate for etching. This may be either of zinc or copper, the choice being determined by circumstances, it may be of economy or otherwise. It has been maintained by many excellent operators, especially in England, that one metal is as good as another, so far as the final results are concerned; but an examination of the work in America will satisfy an unprejudiced scrutiny that finer effects have been obtained on copper. It is possible that different ideas of what constitutes excellence in an engraving may account for the preference. It will be noticed that the American workman seeks after strong contrasts of light and shade, and, not content with that which his negative can supply, has recently resorted to putting the strong lights in with the graver, and by rubbing down the dots has strained after deeper blacks in the shadows. Our cousins on the other side evidently seek after softness of general effect, and by their writings on the subject show that they esteem this as the acme of attainment. Whichever metal is chosen, however, it must be perfectly polished. It may be purchased in several grades of preparation, rough, machine polished, or highly buffed. We think it the best economy to get at least machine polished, and we will assume that it has been so procured.

Polishing the Metal.—If the metal chosen be zinc, it may be brought to a good polish under charcoal and water, but with copper it is necessary to give it a fine grain with emery and charcoal and water, and lastly with charcoal and water alone. In polishing on either metal, let the rubbing be done all one way, to and fro, not in circles or across. After a partial polish, it is well to put it for a few minutes into a strong lye, to overcome any greasiness; and the hands should be perfectly clean, and the fingers not allowed to touch the polished surface of the plate for the same reason.

The Enameling Solution.—The plate being well polished, it is now ready to receive the enameling solution. For this there are various formulæ, each supposed to have merits of its own, and hedged around with all the importance of mysterious secrecy; but the basis of all is a glue or gum, preferably Le Page's fish glue, which is now specially refined and clarified for the purpose, while the sensitizing element is the bichromate of ammonia. To these most operators add a proportion of albumen, and the varying proportions of these ingredients constitute the virtues of the so-called secrets. Some, however, discard albumen; and as the presence of this prevents the keeping quality of the solution, it should only be made up in small quantities for early use, or not more than will suffice for a week or two's work. That made without albumen may be made up in larger quantities, as it will keep indefinitely; but it necessitates more careful washing out after development, the albumen, when used, washing out more readily. We give both formulæ, that the operator may take whichever, after practical experiment, he is most successful with.

Le Page's clarified fish glue	2 ounces
Bichromate of ammonia	120 grains
Albumen	2 ounces
Water	6 ounces

The whites of four eggs of medium size will yield the above quantity of albumen, which take, carefully excluding the yolk and the germ, and thoroughly beat up and set aside to settle. Grind the bichromate with the water, mix with the glue and add the albumen, and beat up the whole again. A common domestic egg-beater is very suitable for this purpose. Make the mixture up in non-actinic or feeble light, and set aside for several hours, when it should be filtered through a small piece of fine sponge in a large funnel, and put into a stock bottle, and again filtered in the same manner before using.

The formula without albumen is as follows:

Clarified fish glue	3½ ounces
Bichromate of ammonia	80 grains
Water	10 ounces

The directions for making given above will app y equally to this. They should be tested with litmus paper, and will more than likely be found acid. Neutralize with a few drops of concentrated ammonia.

Sensitizing the Metal Plate.—The plate having been cleaned and polished, let water from the tap freely flow over it, and, slightly draining the surplus, pour a portion of the solution on at the upper right-hand corner, when it will sweep the water from before it. The solution will have been filtered through a sponge and convenient at hand in the graduate. Flow a second and a third time. Let the surplus at the first flowing run into the sink; if that of the succeeding flowings are thought worth the saving, do not catch them in the graduate from which the solution was poured, but in some other, because so doing will cause air bubbles to form, which will be sure to cause trouble afterward. At the last flowing retain enough to flow back over the plate, and, keeping it in a level position, put it into the "whirler," and whirl, at first with a slow motion, and gradually increasing in rapidity for a minute or so, when it should be examined for any specks or air-bubbles that may appear on the film. If there are any seen it is a misfortune; should they be air bubbles, they may be pricked with a needle, and in the after flowing they will disappear; but if they arise from dust the easiest way is to polish over again and begin from the bottom. These specks are sometimes unaccountably troublesome, and may result from acidity of the solution, so that it is well to prove it with litmus that it is in a neutral condition; if from air-bubbles, the best preventative is to keep the point of the funnel through which the solution is filtered resting on the bottom of the graduate; if they are from dust, it is obvious that the room requires sweeping out, or even the floor mopped and washed out, and to remember that cleanliness is an essential to success. If there are no such manifestations, flow again with the solution, and this time let the whirler be so arranged that a gentle heat may be applied, so it may be dried as quickly as possible. This may be conveniently done by holding the whirler over a gas stove, or other cleanly heat, and

whirl in the same manner as before, which should take about three minutes. Care must be taken, however, not to expose to extreme heat—indeed the less the better—otherwise the albumen may become coagulated, in which condition it would not wash out in development. The plate may now be set aside to cool, and others coated and sensitized, or made ready for printing. Of course, the coating of the plate, it will be understood, is to be done in the dark-room, or with subdued light, and until time of printing set in a dark cupboard or other receptacle.

The Whirler.—The whirler may be of any form that will impart to the plate a rapid circular motion, the idea being to obtain by centrifugal action a perfectly equal distribution of the solution over the plate. Perhaps the simplest form of whirler we have ever known being used was that of a cord suspended over the stove, and twisted till the strain, on being relieved, gave the desired motion, on the principle of an old time cook's roasting jack. Such makeshifts, however,

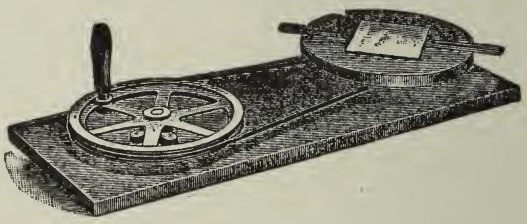


FIG. 19. FORM OF WHIRLER, NO. 1.

should only be resorted to by the genius who finds himself in a corner, and, nothing daunted, is determined never to stick. We give in the following diagrams the forms of two of the most frequently used. The working of the first will be readily understood from the drawing; that of the other we may describe as being made of hard wood, the long arms of thin hickory about $18 \times 4 \times \frac{1}{4}$ inch, around which is placed a broad rubber band. Being of such thin material the arms will spring out to suit almost all size plates within its capacity. The plate is held within grooves at the extreme end, or, what is better, by small screws placed on the outer edge, the heads

of which, holding the plate outside, allows the solution to flow uninterruptedly away under the motion. The diagram will explain how the motion is imparted, and it will also be seen

FIG. 20. FORM OF WHIRLER, NO. 2.

The dotted line indicates the plate in position at A ; B, the rubber band.

that this form of whirler is very convenient for holding in the hand over the heat, and at the same time whirled rapidly by the small handle at the upper end.

Preparations for Printing.—The plate is now ready for printing. To this end let the thick plate glass of the printing frame be seen to as being thoroughly clean ; also the negative. Frequently a moisture will collect on the glass of the negative, to obviate which let it be held over the gas stove for a few seconds. As to the printing frame, it is scarcely necessary to describe it more than in a general way, that it is a square frame about four inches deep, in which is placed a piece of plate glass of from three-quarters to an inch in thickness, of sufficient strength to withstand the pressure necessary to secure complete contact between the negative and the metal plate. This pressure is got from screws, as will be seen in Figs. 21

and 22. The frame must be purchased anyway, and its construction and working will be readily understood when practically examined.

Loading the Printing Frames.—Take the sensitized metal plate and rest on the points of the fingers of the left hand, and place the negative over it so as the picture will fall exactly in the centre; or lay the negative in the printing frame, film side up, and lay the sensitized plate over it. Let this be done gently and without moving about, so as to save any risk of

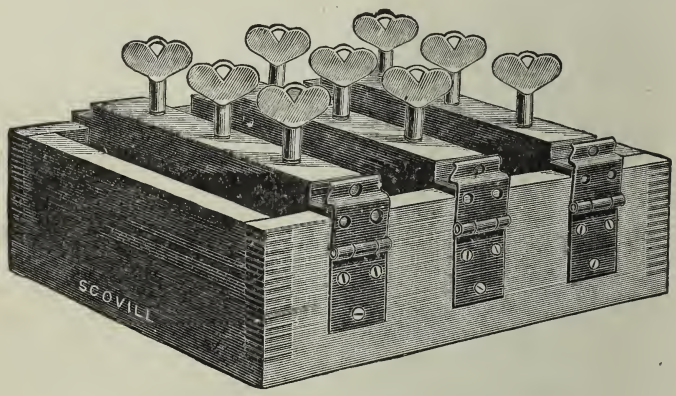


FIG. 21. PRINTING FRAME, CLOSED.

abraiding the film of the negative. Turn over and convey to the printing frame; place over them one or two pieces of felt; put on the cover, and proceed to screw down. This must be done very carefully so as not to break the negative. The safest way is to bring a gentle pressure to bear upon the centre screw, and on the others radiating from the centre, and lastly on the corners, repeating this gently, always beginning at the centre and going over the others until close contact between the negative and the plate is obtained.

The Printing.—The plate is now ready for exposure, with a view to printing; and here judgment and experience, the outcome of experiment, must be the best guide of the student. There are two elements on which he will have to bring his judgment to bear: first, the density of the negative, and, secondly, the intensity of the light. It may take anywhere

from one to ten minutes. If a bright sun is out, and the negative of medium density, one minute may be ample, varying with a cloudy sky or a hazy atmosphere. A few practical experiments and the waste of a few plates will afford better lessons than any written words can convey, and knowledge will come as the reward of patient perseverance.

Development.—Having given what is deemed to be a sufficient exposure, remove the printing frame into the dark-room,

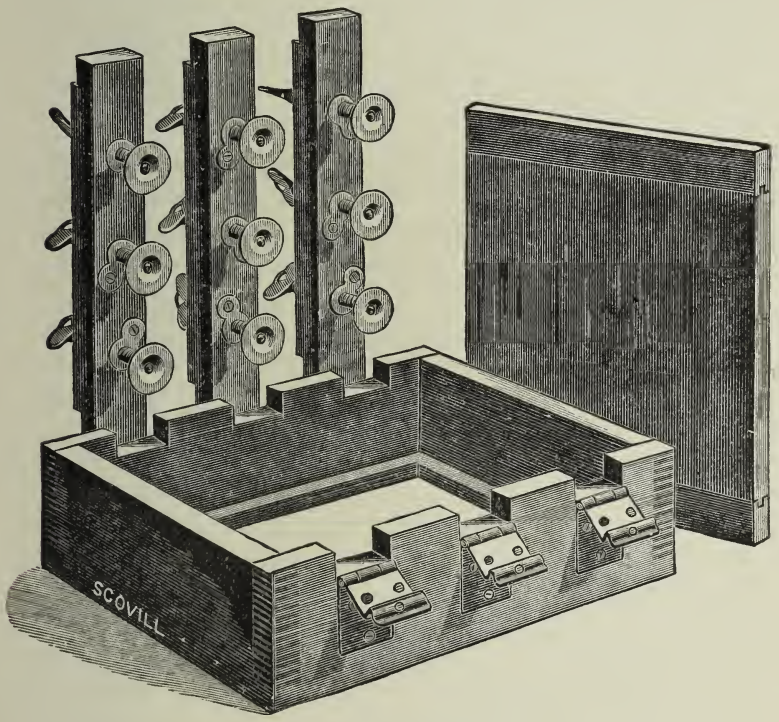


FIG. 22. PRINTING FRAME, OPEN.

unscrew and take out the plate, and place in a dish of slightly warm water, and rock for a few minutes. At this point it may be examined as to whether a correct exposure has been given. If so, the enameling solution will be found a little tough when raised by the finger-nail at any of the margins. If the time given has been too short, it will have washed away

under the action of the water, especially when placed under the tap to wash out, which should now be done. If correctly timed it will stand considerable washing without injury. The effect will have been to wash out those parts of the solution which have been protected from the light by the denser portions of the negative, and the half-tones in varying proportions.

Drying after Development.—Having been sufficiently washed, the drying may be accomplished by being set aside and allowed to dry spontaneously, or, as the manner of some is, to reach the end more expeditiously, the plate may be flowed over with alcohol, and, held in tongs or pincers, a flame set to it, when it will be dried at once and be ready for the next operation, which is the burning in.

Burning In.—This operation is best performed over a small gas-stove, and requires a pair of large pincers, about twelve inches long, with broad point that will hold a good grip of the plate by the margin of the picture. It must be kept moving over the flame to and fro, so as to distribute the heat gradually and regularly over all the plate. In a few minutes it will be seen to change color and the picture to develop out more plainly. At this point it is safer to lay aside for a few minutes to partially cool, as a great heat too quickly brought to bear upon the enamel may cause it to crack; meanwhile, other plates may be proceeded with and brought to the same stage. The burning should be continued until it assumes a rich deep brown, when it should be laid aside to cool gradually, when it is ready for the etching.

Corrections on Film.—Specks and other imperfections will now probably make their appearance, which had before been unsuspected, brought to light by the burning in of the enamel. The plate should, therefore, be examined under the magnifying glass and these corrected with a fine graver. They will appear most injuriously in the high lights, and the remedy is to trim away the film between and so relieve the dots. This is rather a delicate operation and takes careful handling.

The Etching Fluid.—The etching fluid for copper is a solution of perchloride of iron. It is advisable to use it at

full strength at first, gradually diluting. It is a curious fact that the strength of the solution is to a certain extent increased by the addition of water. Make up sufficient to cover the plate well but not so deeply as to prevent seeing its action in etching. A serious objection to using the fluid full strength is, that it is so opaque as to prevent the process of etching being observed and watched.

The Etching.—Pour the solution of chloride of iron into a shallow dish and insert the copper plate. The action of the iron will be at once seen in a change of color, resulting from the accumulation of sediment from corrosion. Brush this off with a soft camel's hair brush, and do so with a light circular motion rather than broad sweeps over the plate. Do so every half minute or so, when it is seen to accumulate over the plate. Occasionally blow the liquid from some part of the surface and keep a keen watch whether any of the dots show signs of etching away, when it must be at once stopped. Should the enamel give way too readily under the etching it was probably too acid, or the exposure under the printing frame had been too short, or the burning in not carried far enough. It may etch deep enough in five minutes to print well, but it is better, for giving greater ease in making ready at press and better printing results, to give a deeper etch, and if the enamel does not show signs of giving way, fifteen minutes may not be too long to give it. The progress and depth may be examined by the finger-nail upon the margin and stopped when it is judged far enough; then taken out and brushed well with the camel's-hair brush under the tap, then dried by gentle heat over the stove.

Enameling the Zinc.—Should zinc be the metal chosen to work with, nitric acid is employed in etching. Zinc plates, ready polished and prepared for engraving purposes, may be obtained, and it is greatly preferable to so purchase them than undertake the labor and trouble of polishing. It must, however, get a final polish with engravers' charcoal before flowing with the enamel solution; and to eradicate any greasiness on the surface it may be placed for a few minutes in the lye used for cleaning the glass plates, and then given the final polish.

The process of flowing the plate with the enamel solution is exactly similar to that described above for copper; but in burning in, the zinc, being a much softer metal, will not stand the amount of heat that copper does, and so the enamel cannot be burned to so deep a color, and, therefore, greater caution is required to burn to a degree sufficiently hard and yet not bring the zinc to the melting point.

Etching on Zinc.—A very weak solution of nitric acid is all that is necessary in etching half-tone work on zinc. A solution of 1 drachm acid to 10 ounces of water, which will to taste be about the strength of vinegar, will be found right. It is usual to use a rocking tub, in which the plate is placed and the solution flowed over from end to end, while the oxidized zinc is gently brushed away; it may be done quite as well, however, in a small porcelain or other flat dish as with the copper plate, and the same watchfulness of the film under the action of the acid must be exercised.

The Etching Tub.—The construction of the rocking tub for zinc etching will be readily understood by the following illustration of the latest and most improved form:

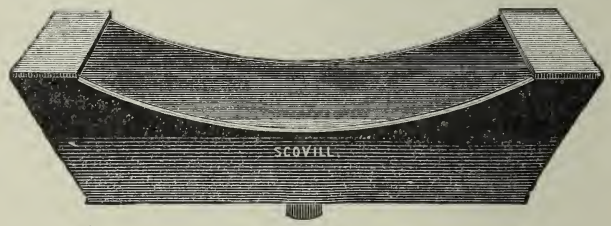


FIG. 23. ETCHING TUB.

Recapitulation.—We might here rest our description of the process; but it will be desirable to recapitulate shortly the various stages and restate the different formulæ, so as to save reference to the larger treatise and present the whole in succinct form.

1st. The Glass.—To be procured flat, clear, and without scratches or blows.

Steep in strong lye for several hours and wash out.

Steep in solution of nitric acid and water. Unless the

washing water is very clear, rinse in distilled or filtered ice water.

2d. Albumenize the Glass.

Formula.

The white of 1 egg in 48 ounces distilled or ice water.

Filter three or four times till perfectly clear. Set on rack to dry facing one way.

3d. Collodionize the Glass Plate.

Formula for Collodion.

Alcohol, 95 per cent	8 ounces
Iodide of ammonia	48 grains
Iodide of cadmium	24 grains
Bromide of cadmium	16 grains
Pyroxyline	120 grains
Sulphuric ether	8 ounces

Dissolve the salts by trituration in a mortar, each separately in a portion of the alcohol; add the pyroxyline and let soak a few minutes; lastly, add the ether, shake well, and set aside to ripen for about a day.

4th. Sensitize the Plate.

Formula for Silver Bath.

Nitrate of silver	40 grains
Pure distilled or purified ice water	1 ounce

Of sufficient quantity to fill the holder. Neutralize with concentrated ammonia, and stand in the sun to purify; then filter. When thoroughly clear put into holder, add C. P. nitric acid, drop by drop, till the blue litmus paper is turned to red. Iodize by allowing a collodionized plate to remain in it over night, when it will be in working order.

Shield the bath from light when inserting the plate.

Five minutes in bath will be enough to sensitize the plate.

Take out, drain, and wipe back of plate with blotting paper.

Put the plate into the camera-holder, close, and attach to camera.

5th. The Screen will have been carefully cleaned and adjusted in the holder.

To clean, use Paris white or prepared chalk in alcohol, afterward pure water, rubbing dry with an old, soft piece of silk.

6th. The Camera.—See the camera correctly set to suit the size of picture to be copied, and the focus perfectly sharp.

Determine what diaphragms to use, and the exposure with each, beginning with the smallest.

Draw the slide, uncap the lens. and set the clock to strike at the end of time given to first stop.

Cap the lens and change stops, giving time of exposure with each.

Having given time determined upon for exposure, cap the lens, close holder, and take to dark-room.

7th. The Developer.

Formula for Developer.

Saturated solution of proto-sulphate of iron.....	12 ounces
Acetic acid.....	2 ounces
Water.....	24 ounces
Or,	
Photo-sulphate of iron.....	1 ounce
Water.....	16 ounces
Acetic acid	2 ounces

Dissolve the photo-sulphate of iron by trituration in a mortar in the water, add the acetic acid, and filter.

Take the plate from holder and flow with above.

Stop development instantly the detail is seen to be fairly out by washing under the tap.

8th. Fixing the Image.

Formula for Fixing Solution.

Cyanide of potassium.....	1 ounce
Water.....	12 ounces

Flow the plate with above, when it will be seen instantly to clear up.

Wash well, take into the light, and examine under a magnifying glass.

The dots in high lights should almost touch; those in deepest shadows should show sufficiently strong to stand clearing down a little, or any fuzziness ronnd their edges cleared away.

9th. Intensification.

Formula for Copper Solution.

Sulphate of copper	25 grains
Bromide of potassium	15 grains
Water	1 ounce

Flow with above solution till bleached white, then wash thoroughly.

Flow with solution of nitrate of silver.

Formula for Silver Solution.

Nitrate of silver	40 grains
Citric acid	5 grains
Water	1 ounce

When seen to be blackened through, wash thoroughly.

10th. Clearing.

Formula for Iodide Solution.

Iodine	40 grains
Water	4 ounces
Iodide of potassium	q. suf.

Add the iodide of potassium, a small portion at a time, sufficient to take up or dissolve the iodine.

Of this solution take enough to make three or four ounces of water a deep brandy color; flow this over the plate two or three times, then wash.

Flow the plate with a *very* weak solution of cyanide of potassium, and wash well.

Formula.

Water	4 ounces
Of cyanide solution prepared for fixing negative	1 drachm

Examine with magnifying glass whether the dots in high lights are clear glass, or black dots in shadows have lost their fuzziness. If not, repeat.

Watch carefully the action of the cyanide, that it is not allowed to go too far.

Flow with a weak solution of nitric acid.

FORMULA.

Nitric acid	1 drachm
Water	4 ounces

Flow with solution of sulphuret of ammonium.

FORMULA.

Hydro-sulphuret of ammonium	4 drachms
Water	2 ounces

Wash well and flow again with the nitric acid solution above.

Set aside on rack to dry spontaneously.

After drying, cut marginal line with graver.

11th. TURNING THE FILM.

FORMULA FOR RUBBER SOLUTION.

Virgin rubber	½ ounce
Benzole	8 ounces

This solution should be thinned with benzole to about the consistency of good collodion.

After the rubber solution has dried, flow with turning collodion.

FORMULA FOR TURNING COLLODION.

Alcohol, 95 per cent	4 ounces
Pyroxyline	60 grains
Sulphuric ether	4 ounces
Castor oil	30 drops

After quite dry, cut the film through with a sharp knife, about a quarter of an inch from the marginal line.

Place the plate in a solution of acetic acid and let lie for about five minutes.

FORMULA.

Water	8 ounces
Acetic acid	1 ounce

Remove the film outside the cut line.

Wash the film under the tap, gently but thoroughly, and lay on table with plenty of water on surface.

Wet a piece of strong printing paper and lay on film and squeegee.

Pick up corner of film with penknife and lift with paper support, and lay on glass, film up.

Wet another piece of paper and lay on film, and squeegee.

Turn over, take off first sheet of paper, and lay aside.

Wash the glass thoroughly under the tap and lay on paper with plenty of water.

Lay the film on centre of glass with paper support over it, and squeegee.

Remove paper and examine for any wrinkles; smooth out and replace paper.

Place two or three pieces of clean blotting paper over it, and put under a weight for about half an hour, take off the paper, and set aside to dry.

12th. Enameling the Metal Plate.

Prepare the sensitive solution for enameling the copper or zinc plate.

Formula for Enameling Solution.

Le Page's clarified fish glue	2 ounces
Water	6 ounces
Bichromate of ammonia	120 grains
Albumen	2 ounces

Formula for Enameling Solution without Albumen.

Clarified fish glue	3½ ounces
Bichromate of ammonia	80 grains
Water	10 ounces

Polish the copper plate, first with fine emery, and lastly with charcoal and water alone.

Zinc needs no emery in polishing.

Flow with sensitizing solution twice and put in "whirler," and put in motion for about a minute; then flow again with solution, and this time hold over a gentle heat till dry, then set aside in the dark to cool.

13th. Printing the Metal Plate.

Prepare the printing frame, in which lay the negative and

plate, lay over them one or two thicknesses of soft felt, then the cover, and screw down.

Begin screwing down with centre screw, gradually going over the whole, the corners last and most gently.

Set in the sun, and expose the time judged needful—one to three minutes; in cloudy weather, from three to twelve minutes, according to density of negative.

Remove from printing frame in dark-room and place in lukewarm water; rock for about three minutes and wash thoroughly under the tap.

Set aside to dry spontaneously, or flow over with alcohol and burn dry at once.

14th. Burning the Enamel.

With the plate held in pair of pincers, hold over a gas or other clean burning stove till it comes to a rich, dark brown.

15th. Etching.

Formula for Copper.

Solution of perchloride of iron	1 ounce
Water	6 ounces

Formula for Zinc.

Nitric acid	1 drachm
Water	10 ounces

Place solution in a shallow dish and insert the plate, gently brushing away the oxidation which occurs, with a camel's-hair brush, going over the plate in small circles.

Etch from five to fifteen minutes, carefully watching for any break in the enamel.

For zinc a tub may be used, flowing the solution over the plate by rocking.

Wash well under the tap, and dry somewhat quickly over the gas stove.

Mount on wood, prove on press, and *rejoice at your success!*

Conclusion.—Our task is ended. We have endeavored to describe the process with the utmost plainness—indeed, so plain that "he who runs may read"; and if our directions are

attended to with ordinary intelligence and care, there cannot be a doubt but that the result will be a gratifying success. It will only remain to finish the work by mounting on wood, to the height of type, to suit it for printing by the typographic process. To do so, however, will require machinery of an expensive character, and the use of power for its operation; and unless the student purposes going into the business on an extensive scale, it will be found more economical to engage that this part of the work be done by some electrotyper already possessed of the appliances. But if he has determined on having a perfect outfit, the manufacturers of such machinery will only be too glad to furnish him with reliable data concerning it.

APPENDIX.

THE Enamel Process, as described by Mr. Whittet, will produce the best results if strictly adhered to. However, there is diversity of opinions as to formulæ which present the least difficulties, with less chances of failure, and at the same time which will produce the best results. We desire to embody in this short appendix the formulæ recommended authoritatively by Professor Todd, of the Chautauqua School of Photography, who is an expert photo-engraver, and who has been interested in the Enamel Process from its infancy. Professor Todd prefers to work on copper, and his stock for those who desire to begin work is as follows:

Three trays, a little larger than the largest plate to be used, and preferably made of the composition commonly called vulcanite, one eight-inch Wedgewood mortar and pestle, some fine charcoal for polishing the plate, an egg-beater, and the necessary graduates and funnels. The chemicals required are as follows: S. P. C. pure bichromate of ammonium—let us say, half a pound, to establish the proportion in which the chemicals should be ordered—pure gum arabic, five pounds; pure white rock candy, two pounds; solution of perchloride of iron as sold by the chemists; bichromate of potash, five pounds; common sulphuric acid, five pounds.

The Enamel solution is prepared as follows:

Pure gum arabic	400 grains.
Pure rock candy	80 grains.

This is placed in the mortar and ground to powder with the pestle, and then transferred to a 16-ounce wide-mouthed

bottle, to which is added 8 ounces of distilled or pure rain water. Stir with glass rod until dissolved. Add, besides, 45 grains S. P. C. bichromate of ammonia. Take the whites of three eggs, carefully separated from the yolks, beat thoroughly, and add to above solution; shake well and filter twice through calico or muslin, then again through absorbent cotton placed in the neck of a glass funnel. The solution is then allowed to ripen for twelve hours, when it is again filtered through cotton, and thus made ready for use. This solution will keep in good condition for about a week.

TO SENSITIZE THE COPPER PLATE.

Take a copper plate about one inch larger each way than the negatives. Polish perfectly with charcoal, not allowing the fingers to touch the surface at any time during or after polishing. This polishing must be done with plenty of water flowing over the plate. When polished, rinse perfectly clean under tap and at once remove to room lighted by gas or unprotected lamp.

The plate must be kept wet and coated as soon as possible to prevent oxidation. Allow the wet copper plate to rest on the finger-ends of right hand, and take the whirler in the left, jaws up and hinges down; separate the boards and place plate between, just under the tacks and face upward. When whirler is turned over for action the hinge end will be up and the plate end down, with plate face down. While holding whirler, with plate face up, pour a little solution on the plate, and cause some to flow completely over the plate as collodion is flowed to coat the negative. Tilt plate and drain off into sink; repeat the operation without allowing any solution to run off; then reverse whirler by a dexterous movement, which will be learned by practice only, striving to keep solution from running off the plate, or from running to one end. Quickly take hold of knob at top with left hand and proceed to slowly rotate whirler by crank under knob.

Begin at about two turns per second, and slowly increase the rapidity till the plate is dry. All this time the small gas, or oil, stove should be burning under the plate to dry it. The

plate should be at a distance of about thirty inches from fire. The plate should take about five minutes to dry, and when perfectly so, allow it to cool, and it will then be ready for the printing frame. Do not allow the plate to become hotter than can be borne by the hand.

Printing.

Place negative in pressure-screwframe and carefully lay copper plate, with the coated side down, on top of the negative, and fit in the back of the frame. Turn down the screws, but do not use excessive pressure. If negative is good and clear expose to the full sunshine from two and a half to three and a half minutes.

Development.

Retreat to dark-room and remove the plate. The image will be barely visible on it. Fill one of the trays with clean, clear water, at about 100 deg. Fahr., to a depth of about one inch. Lay the plate in, face up, and gently rock tray for about two minutes. Remove and wash well under stream from tap. Drain a moment and place plate in a tray of alcohol (grain, not wood) for about a minute, to remove the water, then take out and rack to dry.

It will take from ten to fifteen minutes to dry, when plate will be ready to "burn in." Light the large stove and quickly, but evenly, heat plate until the enamel assumes a dark mahogany color, and the bare copper turns to a bluish-white or steel color. The plate is then allowed to cool preparatory to etching.

Etching.

The solution of perchloride of iron is first used undiluted as it becomes more active when water is mixed with it.

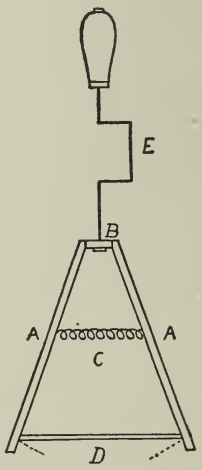
Varnish back of plate with weak alcoholic shellac varnish, and dry thoroughly. Lay the plate in the tray and pour a sufficient quantity of the iron solution to cover it. Immediately pass a camel's hair brush over the plate to remove all air bubbles, specks of dirt, etc. The proper depth to which the plate must be etched can only be learned by experience, but

it is safe to say that, with new iron solution, about fifteen to twenty minutes will suffice. When etched sufficiently deep, remove and wash under tap. Try a proof, and, if satisfactory, clean carefully with benzine and clear plate in the following solution:

Saturated solution, bichromate potash.....	4 ounces.
Water.....	8 ounces.
Common sulphuric acid.....	1½ ounces.

This solution should be at least twelve hours old. Place the plate in this solution and quickly rub over with a wad of cotton. This brightens the bare copper and improves the appearance. When the iron solution gets old and slow, a little water can be added. When 25 per cent. of water has been added, throw away, and use new iron solution.

The following is a rough sketch of the whirler, or device for holding the plate while drying, which Prof. Todd suggests:



AA. Two Boards ¼ inch thick, 4 inches wide, joined at B with hinges C spring to draw AA together, so as to clamp plate D.

E. The means for producing a rotary motion to the whole.

The two boards indicated by AA must be, at least, as long as the largest plate to be used, and to serve as a rest for the plate two tacks are driven on the inside of each of the boards, about half and inch from the ends.

Order List.

The beginner is so often puzzled in making out his first order list that the following will be found of great help as a guide:

1	10 x 12 Scovill Enlarging, Reducing and Copying Camera, fitted with Patent Screen Plate Holder..	$56 00
1	Camera Swing	20 00
1	Copy Board	2 00
1	Max Levy Screen, 133 lines to the inch, 10 x 12	80 00
1	Rectilinear Lens, Rapid Paragon, 10 x 12, w. D	68 00
2	2-quart Funnels, glass, 25c	50
6	8-ounce Funnels, glass, 12c	72
1	Package No. 33 Filtering Paper	75
2	Hydrometers, 50c	1 00
2	11 x 14 Glass Baths in Studio Box, $7	14 00
1	Rubber Dipper	60
1	2-gallon Evaporating Dish	3 00
2	10 x 12 Porcelain Trays, $1.66	3 32
2	10 x 12 Vulcanite Trays, $1.75	3 50
2	16-ounce Graduates, 75c	1 50
4	4-ounce Graduates, 30c	1 20
1	9 x 11 Printing Frame, 1-inch glass	9 50
1	8 x 10 Retouching Frame	3 75
2	Large Negative Racks	6 00
1	13-inch French Hand Roller	7 00
1	Composition Roller, 12-inch	4 00
2	Pincers	2 00
2	Acid Brushes	3 50
1	Ink Spatula	1 00
1	Hook for cutting Zinc Plates	1 50
	Retouching Brushes	50
1	gallon Absolute Alcohol	4 00
3½	pounds Ether	2 63
4	ounces Pary's Gun Cotton, 50c	2 00
4	" Iodide Potass., 30c	1 20
2	" Resubl. Iodine, 35c	70
3	pounds Nitrate Silver Crystal, $8.50	25 50
1	" Absorbent Cotton, 1 pound packages	75
5	" Protosulphite Iron, 10c	50
1	" Citric Acid	70
1	" Bichloride Mercury	1 00
5	" Cyanide Potash	3 25
1	" Glycerine	30
5	books Blue Litmus Paper, 5c	25.
1	pound Aqua Ammonia fort	32

½ pound	Nitric Acid, C. P.	$0 45
1 gallon	Benzole	1 50
1 pound	Bichromate Ammonia	75
1 "	Caustic Potash	15
8 "	Commercial Nitric Acid, 45c.	3 60
1 "	Ferri Chloride, 1 bottle	30
1 "	Rubber Cement, 1 can	30
1 "	Nitrate Lead, 1 bottle	1 00
1 "	Ferricyanide Potash, 1 bottle	1 00
½ "	Transfer Ink	2 55
½ "	Engravers' Charcoal	1 50
1 "	Pumice Stone	10
5 "	Sulphate Copper, 40c.	2 00
2 "	⅜-inch Brass Pins, 40c.	80
1 "	Lithograph Ink, black	3 50
2 gallons	Le Page's Liquid Glue, $2.25	4 50
1 set	Engraving Tools	1 50
1 "	Finishing Tools	2 50
1	½-inch Flat File	50
1	1-inch Flat File	85
1 set	Assorted Sable Pencils, Nos. 1 to 6	62
1	Darlot Focusing Glass	2 50
1	5-inch Engravers' Pad, filled	1 00
1	Egg Beater	30
1 set	Roulettes	6 00
1	16-ounce Plain Collodion Vial	55
1 pound	Best Dragons' Blood	85
Polished Zinc Plates, square inch		01
"	Copper Plates "	01¼

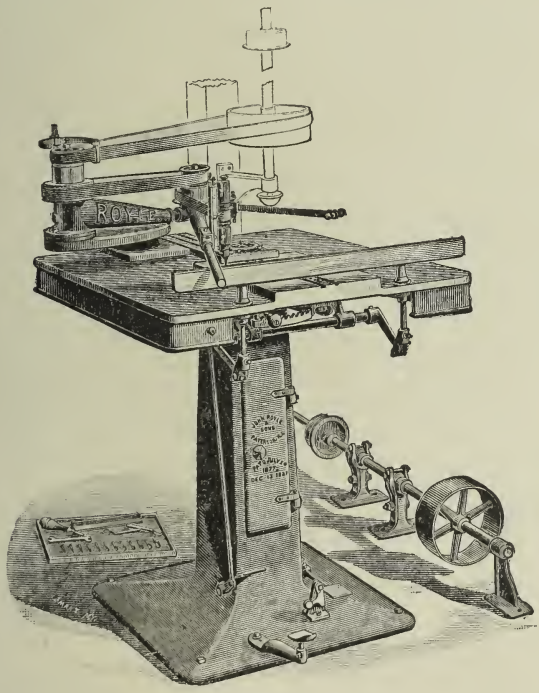
THE VALUE OF MACHINERY IN PROCESS-ENGRAVING.

There are two sides to process-engraving; the artistic and the commercial; and while the artistic side may be said to end with the completion of the plate—up to which point but little in the way of machinery is required—the commercial side proceeds through the various operations of blocking and preparing the plate for the printer, all of which are of great importance, and demand not only perfect accuracy in all dimensions, but rapidity of execution as well, time being money to the engraver as well as to others.

Engravers' machinery, to give satisfaction, should possess characteristics not always present in the ordinary run of

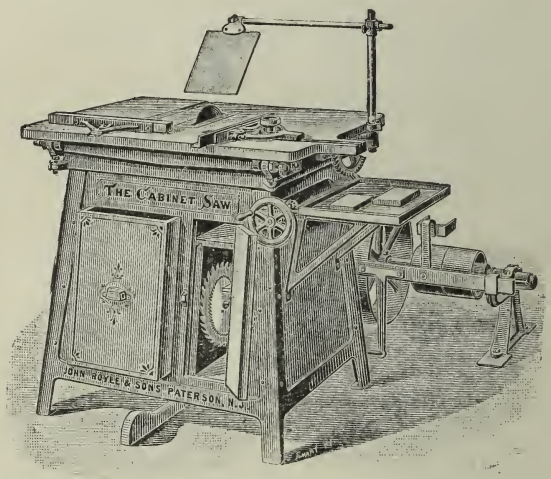
machinery. One prime essential is the capacity for doing work with mathematical accuracy. The importance of this will be at once apparent, as it is clear that inaccurate work in the finishing or blocking of the plate will necessarily be followed by corresponding irregularity in the printing, working destruction to the carefully studied effects of the artist.

A few illustrations of the leading machines at the command of the engraver, together with short explanatory remarks as to their uses and powers, may not be amiss.



The Router is entitled to first mention, as it is one of the oldest machines used in the engraving trade, and covers an exceptionally wide field, although it is not so extensively used in half-tone work as in other branches. The purpose of this machine is the cutting away of such parts of engraved plates or blocks as it is desired to leave blank in the printing. This is accomplished by means of a rapidly revolving cutter, set in a

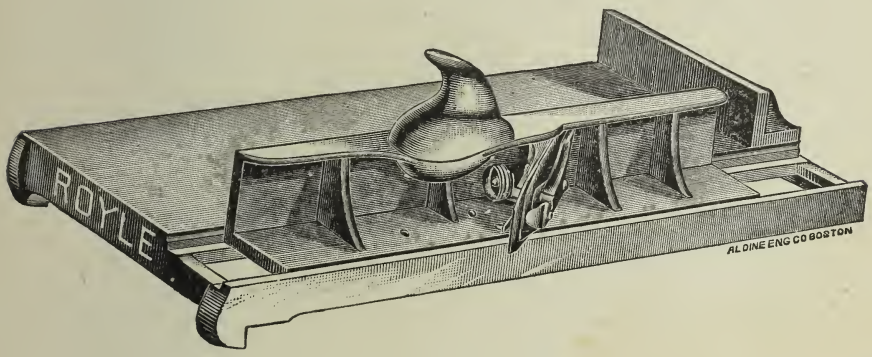
spindle at the end of a projecting arm, and varying in shape and size according to the work to be performed. There are two classes of routers; those in which the spindle is set at the end of a movable arm, the work being securely attached to the table while being routed; and those in which the spindle is fixed, the work not being fastened to the table on the machine but sliding freely beneath the cutter. The first form of construction is much to be preferred on account of the superior facility with which work can be done. The fixed spindle machines, however, can be constructed very cheaply, and can sometimes be used to advantage where the quantity of routing to be done is limited.



A machine almost universally serviceable in an engraving establishment is the saw-table. The engravers' saw table, to answer the requirements of the case, should be a machine of the most absolute reliability and accuracy, and should be used for sawing and nothing else. It is customary, with some engravers, to combine other machines with the saw-table. There is no true economy in this, and the idea that good work can be done on a machine of this sort is fallacious. The chief requirements of this machine are that

the bed, or table, should have an absolutely even surface, and that it should be equipped with perfectly reliable gauges. Further than this, it should be sufficiently powerful to cut the softer metals with facility, and the mechanical construction should be such as to insure a continuance of relative accuracy, between the various parts, for a considerable length of time. A poorly-made saw-table is a genuine affliction, and a good saw-table is a constant convenience.

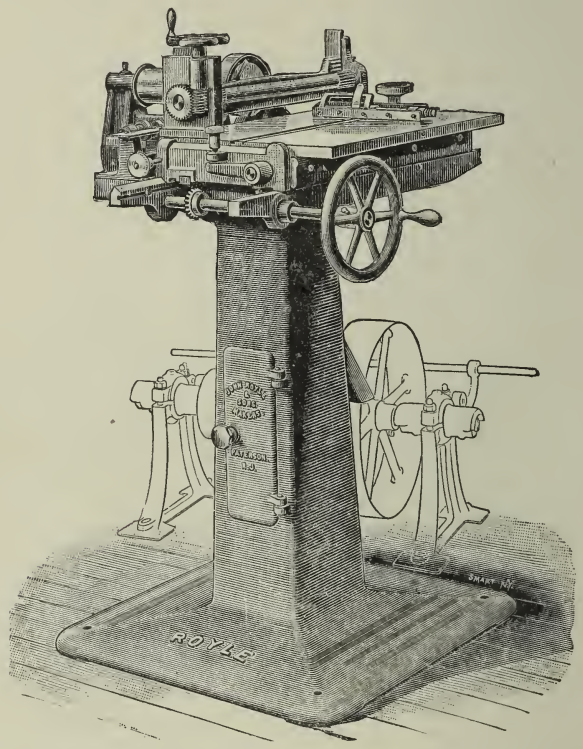
While some engravers are satisfied with sending out blocks just as they leave the saw, without further finish, it is generally the custom to smooth off the edges with a shoot-board or trimmer. The shoot-board is simply a heavy, iron bed, with a



plane running in a groove at the side, and equipped with a square fence at the end against which the blocks are set while being planed. The shoot-board is operated by hand, not requiring power. For doing the work more rapidly, power-driven edgers are used, performing the same functions as the shoot-plane, but doing the work much more quickly.

One of the most important machines in half-tone work is the beveler. This machine is intended to be used, as its name implies, for cutting a bevel, or rabbet, around the edge of the plate preparatory to blocking. The necessity for this is apparent, as unless a suitable place is provided for driving the nails, their heads will appear above the surface of the engraving, marring the plate and showing in the printing. The beveler is the most effective machine obtainable for doing

this work, although the same service can be performed on the router. Routing the bevel is, however, many times slower, and the results are not as neat and finished as those obtained with beveler.



The machines enumerated above are those vitally important to the successful operation of an engraving plant on a commercial basis. There are others more or less important, according to the volume of business done; but with a good router, saw, shoot-board and beveler, the average engraver is very well equipped in the mechanical branch.

It is of the first importance that those entering the field with a view to doing commercial engraving should be properly equipped to turn out work on a commercial basis. Well constructed machinery will do a great many things faster and

better than they can possibly be done by hand, and all first-class engraving establishments pay close attention to this department, knowing that profits are dependent, to a great degree, on rapid, perfect work.

As few engravers have either the time or the inclination to study mechanics deeply enough to determine the true merits of a machine in any other way than by actual practice, it will be found that the reputation of the maker is the safest guide to follow in selecting this part of the outfit. The oldest and best-known firm, making a specialty of engravers' machinery, is that of John Royle & Sons, Paterson, N. J., U. S. A. The first work of this description ventured on by this firm was the

construction of routing machines for the manufacture of wood-type. Several machines of this class were built by the Royles at a period ante-dating the civil war, and since that time they have continued in the field uninterruptedly, improving and adding to their line of machinery and keeping pace with the increasing demand for improved facilities. One important factor in determining the adoption of engravers' machinery, by this firm, as a leading specialty, was that the present manager of the business was, for many years, in close touch with the trade in New York City, and thus acquired a prac-

tical knowledge of the needs of the business that could not have been attained in any other way. This special knowledge, combined with a thorough comprehension of mechanical principles and the limits within which they can be successfully applied, have been put to good use in developing a line of machinery of the greatest utility in all branches of commercial engraving.

THE EDITOR.

DRY PLATES INSTEAD OF THE OLD PROCESS.

Prof. Todd has been very successful in his experiments with the Carbutt Process Plates, and it will not be amiss to quote from the valuable article which appeared on the subject in *The Photographic Times.*

"Since the advent of what is now called the half-tone photo-engraving method, the making of the negative has, by the majority of operators, been accomplished by the wet collodion process, as the more rapid gelatino-bromide plate was not amenable to the treatment of clearing and intensifying used in the wet process. It is the purpose of this article to show and prove that, by the use of a specially prepared process plate made by the writer, equally as fine half-tone blocks are produced as by the wet-plate process, and have been used for a year or more past by firms who formerly used the wet-plate method, but have laid it aside to the exclusive use of the gelatine process plate. As the gelatine plate is always ready for use, and more sensitive than the bath plate, and the time taken up in developing, clearing and intensifying, being about the same as the wet plate, much valuable time is saved, besides relieving the operator of preparing collodion, keeping silver baths in order, etc. The same plates are used in producing negatives of pen drawings, reproduction of wood engravings for transfer to stone, or producing deep etched blocks. The following solutions are required for developing, clearing, fixing, reducing and intensifying the process plates:

DEVELOPING FORMULA FOR HALF-TONE (SCREEN) AND NEGATIVES OF PEN DRAWINGS.

No. 1.

Neutral oxalate of potash	1	pound
Warm water (free from lime salts)	48	ounces

Add of a strong solution of citric acid enough to just turn litmus paper red.

No. 2.

Sulphate of iron	½	pound
Warm water	24	ounces
Sulphuric acid	15	drops

No. 3.—RESTRAINER.

Potassium bromide	½	ounce
Water	10	ounces

TO DEVELOP.

"To 5 ounces No. 1, add 1 ounce No. 2 and 10 drops No. 3.

"To get an even developed plate, use sufficient developer to well cover the plate, allow to act until, on looking through, the image appears quite dense, then wash and place in clearing bath one or two minutes.

No. 4.—CLEARING BATH.

Water	20	ounces
Alum	1	ounce
Citric acid	¼	ounce

"Again wash and immerse in fixing bath.

No. 5.—FIXING BATH.

Water	6 ounces
Sulphite soda	2 ounces
Water	2 ounces
Sulphuric acid	1 drachm
Water	48 ounces
Hyposulphite soda	1 pound
Water	8 ounces
Chrome alum	1 ounce

"Dissolve in the order given, add the solution of sulphuric acid to the sulphite of soda; add this to the hyposulphite, and finally add the solution of chrome alum.

No. 6.—Reducing Solution.

Ferricyanide potassium	50 grains
Water	10 ounces

No. 7.—Bleaching Solution.

No. 1.

Bichlor. mercury	240 grains
Chloride ammonia	240 grains
Distilled water	20 ounces

No. 2.

Chloride ammonia	340 grains
Water	20 ounces

No. 8.—Cyanide Silver Solution.

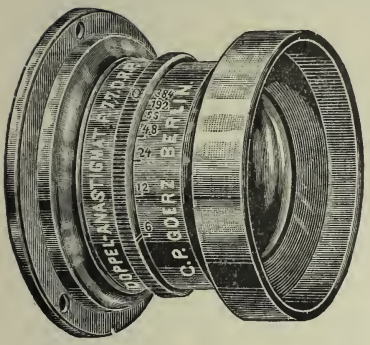
Distilled water	6 ounces
Cyanide potass. C. P.	60 grains
Distilled water	2 ounces
Nitrate of silver	60 grains

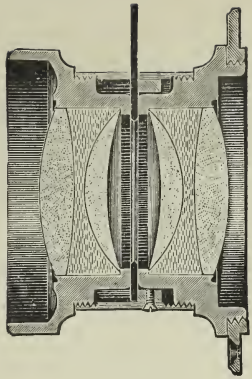
"Pour the silver into the cyanide solution while stirring, and mark bottle *Poison.*

"*Notes on using the foregoing Solutions.*—Supposing that 6 ounces of developer are mixed, and a number of plates are developed, if bulk is reduced to 4 ounces, add 2 ounces of a fresh mixture and no bromide; also if what is left is placed in a bottle, on using it the next day, mix half of it and half of fresh mixed developer, and it will be found to work more uniform than the developer freshly mixed, the old acting as a restrainer. *Always* use No. 4 solution after washing off the developer, as its function is to remove any trace of iron left in the film, which if not removed will leave an opalescence in the clear spaces, also to harden the film and prevent its swelling up. After a stay of not less than two minutes in No. 4 solution, the negative is thoroughly rinsed and placed in No. 5 fixing bath, and when thoroughly cleared, remove. Do not proceed to wash out the hyposulphite as is ordinarily done, but simply *pass* the negative through water to remove the surplus hypo solution on surface, then examine with magnifying glass to determine whether any reducing or clearing is required, either as a whole or locally, which I consider is best done at this stage, as the hypo left *in* the film acts with the reducer—ferricyanide of potash—much better in clearing the transpar-

ent places; then if a mixture of hypo and ferricyanide were used after all hypo had been washed out, the five grains solution of No. 6 can be used as a bath in a white porcelain dish, and the reducing effect watched closely, then removed, and its action immediately stopped by washing. If any part of the negative is found to require local reduction, the No. 6 solution can be applied to the part to be reduced with a tuft of absorbent cotton, or large round camel hair brush and then washed to remove all hypo. If intensification is required it is best done after the negative has been allowed to dry, but as time is of the utmost importance in this class of work, intensification can be done now, the only danger being of any hypo remaining in the film, which would cause a yellow stain after being intensified. To avoid this place in No. 4 for one minute, then wash and place in the mercury solution until whitened, then wash again, and reduce the chlorized image to black, either with a 10 per cent. solution of sulphite of soda or the cyanide of silver solution; the latter gives the clearest and most dense deposit; wash for a few minutes and dry spontaneously, or, if desired to dry quickly, it may be dried in warm air, at a temperature of 90 to 100 degs. Where electric light is used, if the negative is placed before a small electric fan, it will dry very rapidly, as the film of gelatine on these process plates is very compact, and does not swell up to any appreciable extent. I think I have now explained sufficiently the mode of using the process plate for producing half-tone negatives from which blocks can be made that will furnish prints of the highest quality, and enable those who are tired of the vagaries of the *old* wet method, to realize that time, patience aud money is saved by adopting the *new*. For those who do not use a prism to reverse the image, Carbutt's Stripping Process Plates can be used, and are treated just the same as plain plates; when dry they are placed on a leveling stand, on three points, brought to a level, the plate covered with Carbutt's Stripping Medium, using 2 ounces for 8 x 10 plates; $1\frac{1}{2}$ ounces for $6\frac{1}{2}$ x $8\frac{1}{2}$; $\frac{3}{4}$ ounce for 5 x 7. In a warm room it will dry in 12 hours, or over night."

German Patent, No. 74,437.
American Patent, No. 528,155.





Goerz Double Anastigmats

Are by all authorities said to be

MOST PERFECT LENSES.

Series III. Universal Lens.

Series IV. especially for Photo-Engraving Work.

PRICES REDUCED 20 PER CENT.

Ask for Catalogue, Testimonials and Test-Chart.

FOR SALE BY ALL DEALERS OR

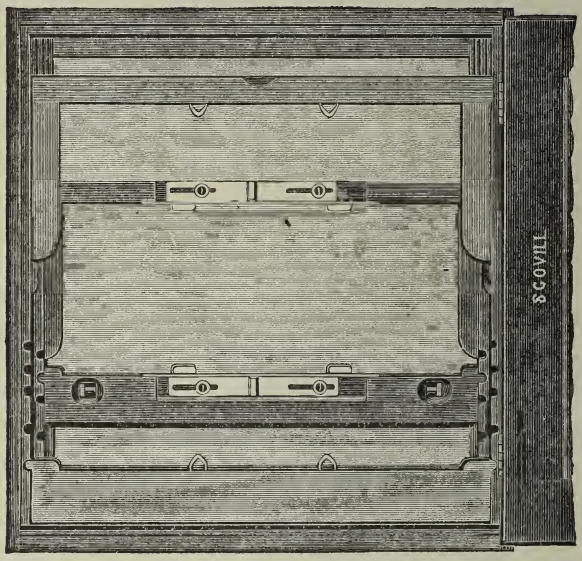
C. P. GOERZ,

FACTORY AT
Berlin, Germany.

52 Union Square (East),
New York.

THE S. & A. PHOTO-ENGRAVERS'

Adjustable Screen Plate Holder.

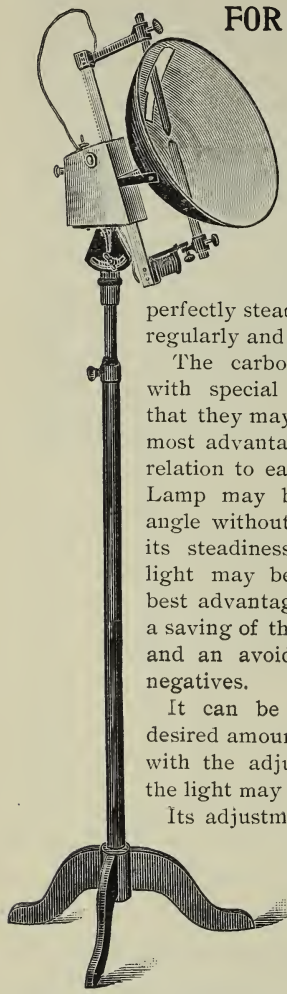


THE BEST MAXIMS are the most often repeated, so we will once more call attention to the fact that without the **S. & A. Photo Engravers' Adjustable Screen Plate Holder,** none of the finest results can be obtained in the half-tone process. The holder has the additional advantage of saving a great deal of time and labor, while reducing to the minimum the chances of dropping the costly screen. The expert photo-engraver knows all this very well, for the S. & A. Holder is in use in all the leading establishments in this country; but it is the prospective engraver and investor who should heed the advice of the practical workers.

Improved Automatic Electric Lamp

FOR PHOTO-ENGRAVING, ETC.

COLT SYSTEM.

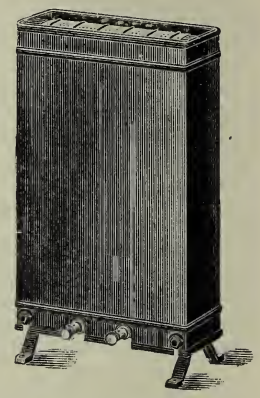


THIS Lamp is constructed on entirely new and scientific principles. Its advantages are that it gives a perfectly steady light: it feeds regularly and uniformly.

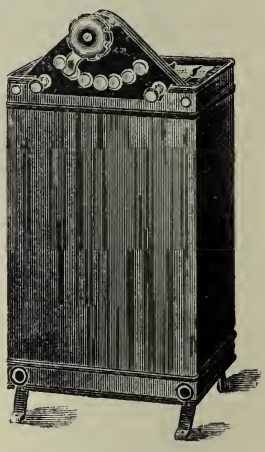
The carbons are provided with special adjustments, so that they may be placed in the most advantageous position in relation to each other, and the Lamp may be tilted at any angle without interfering with its steadiness; therefore the light may be utilized to the best advantage, thus effecting a saving of the operator's time and an avoidance of spoiled negatives.

It can be used with any desired amount of current, and with the adjustable Rheostat, the light may be varied at will.

Its adjustments are few and positive; it is easily managed and gives no trouble or annoyance to the operator.



Fixed German-Silver Rheostat.



Adjustable German-Silver Rheostat.

Lamp with Fixed Rheostat.

Price, $110.00. Discount according to quantity.

As these Lamps are designed for use on low tension or incandescent currents, but are **not** interchangeable on the direct and alternating circuits, inquirers will please state which form of current is available and its voltage.

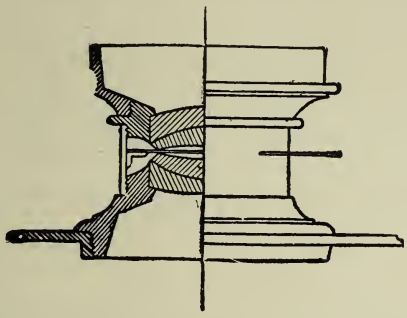
These Lamps are also being introduced for theatre stage lighting, and are rapidly taking the place of calcium lights, producing a more powerful light and being much more economical to operate. Owing to their steadiness, they are also in general use for stereopticon and enlarging purposes; in fact, they are available wherever a perfectly steady self-focusing arc lamp is desired.

The feeding of the carbons is positive, **not depending on gravity**, so that the lamp may be placed at any angle, and may be operated with the carbons in a horizontal position if desired.

THE SCOVILL & ADAMS COMPANY OF N.Y., 423 Broome Street, New York.

STEINHEIL'S

Wide-Angle Copying Aplanat.



Series VI.

Specially designed for copying Line Work, Paintings, Engravings, etc. Without a rival for microscopic snarpness evenly divided over the whole field.

Steinheil Prisms, Series VII.

For use in connection with the above lenses for obtaining reversed negatives without stripping the film.

The above Lenses and Prisms are being extensively used in the largest photo-mechanical establishments in preference to the most expensive lenses of other types.

Stoess & Co.'s Gelatine.

TRADE  MARK.

IMPROVED GELATINE

For Emulsion and Lichtdruck.

WRITE FOR CATALOGUE AND PRICES TO

H. G. RAMSPERGER & CO., Sole Agents,
180 Pearl Street, New York.

CRAMER PLATES

Cramer Lightning Plates:

BANNNER—Best Plate for general use.

CROWN—Especially recommended for Hand Cameras and Instantaneous Work.

Cramer Isochromatic Plates:

SLOW—Full Isochromatic Effect without the use of a Color Screen.

MEDIUM—For Landscapes, Interiors, etc.

INSTANTANEOUS—For Portraits.

We will, in future, ship our Isochromatic Plates direct to the consumer and charge to any dealer he may designate.

Cramer Transparency Plates:

For Lantern Slides, etc.

Cramer Stripping Plates:

For Photo Mechanical Work.

Cramer Non-Halation Plates:

The only Single-Coated Non-Halation Plate on the market.

Ask your Dealer for new discounts on Banner Plates.

Full descriptive catalogue sent to any address upon application.

New York Office: 265 Green Street.

Photo-Engravers

Purchasing their Apparatus of us can obtain complete instruction in the "Half-tone" Process at the minimum cost of

$50.00.

The instruction is given in our own laboratories, at **423 Broome Street,** by a practical photo-engraver, formerly instructor of the Chautauqua School of Photography,

W. G. Todd.

We have a new and very complete illustrated catalogue devoted exclusively to photo-engravers' apparatus and supplies, which we are always pleased to send to any address, postpaid, on application.

We also have a complete line of photo-engravers' requisites on exhibition at our salesrooms which we take pleasure in showing to interested parties. Correspondence is solicited.

The Scovill & Adams Co. of N.Y.

PHOTO-ENGRAVING DEPARTMENT,

423 Broome Street, New York.